MACHINERY

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CLAMPING AND LOCKING DEVICES APPLIED TO MACHINE TOOLS*

By JOSEPH G. HORNER†

DEVICES for clamping and locking various parts are found on practically all machine tools, and the different methods used afford a very interesting study. In considering this subject we disregard permanent fastenings—that is those which are not released and tightened as part of the operation of the machine—and take into account only those devices which are expressly designed to permit of more or less rapid loosening and tightening, to allow of adjustments. There are a great many conditions under which these devices are required, and the particular type adopted may vary widely in character; a design that is exactly suited to one case may be utterly unsuitable for another. For instance, the pressure from the point or end of a screw is sufficient for holding some parts, but in other cases this would be an unsatisfactory method to adopt. Again, friction may be ample to hold a certain part, while in another case a positive device is necessary.

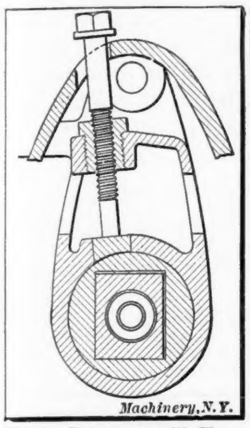


Fig. 1. Set-screw with Shoe for Clamping Sleeve

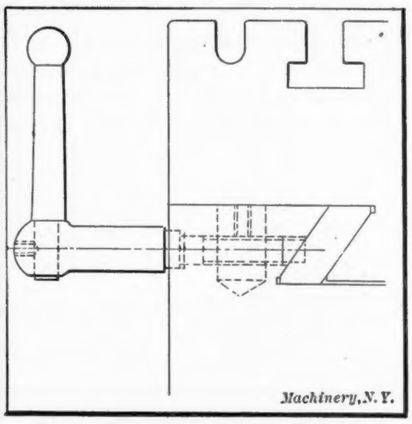


Fig. 2. Screw Recessed into Strip for Clamping Slide

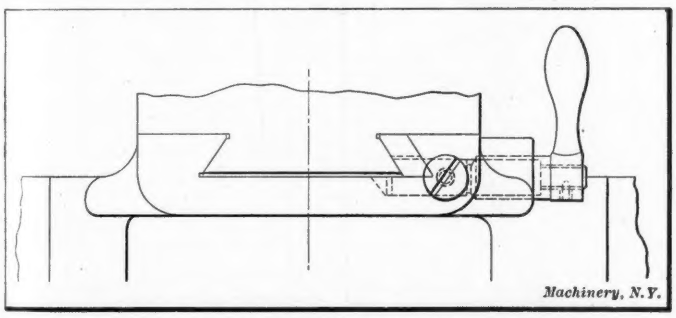


Fig. 3. Screw and Notched Shoe for Clamping Slide

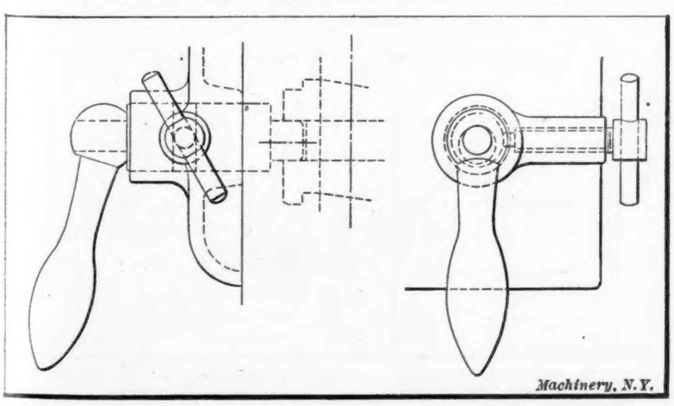


Fig. 4. Clamping Screw with End entering Groove for Clamping Stud

The distinction which will be made in the following between clamping and locking is this: Clamping produces a decided pressure, sufficient to enable a part of a machine to resist the shocks or vibration tending to shift it, while locking is only a method of temporarily holding a piece in position, by means of a plunger or other medium, sufficient to retain it, but without giving a powerful clamping or squeezing action. A locking device, therefore, might not be powerful enough to act as a clamping device, so that these two functions must be regarded as distinct from each other. As a matter of course we say that a slide is locked, when we ought to say that it is clamped, because the parts are drawn together powerfully, and not merely prevented from shifting by a pin or other means. As a general rule it may be said that locking holds a machine part in a definite position, or in one of a series of positions previously known, by means of holes, slots, or grooves, which determine these positions; but a part may be clamped at any location, with or without the use of graduations or other means to determine the setting. In some cases, although these are not very common, locking and clamping are combined, the latter supplementing and assisting the former.

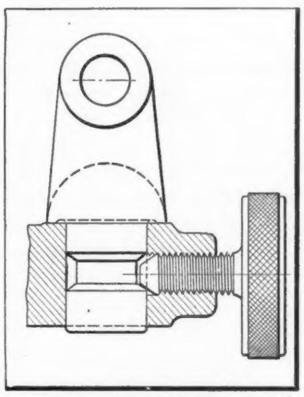


Fig. 5. Clamping Screw with Pull-down Action for Clamping Bearing

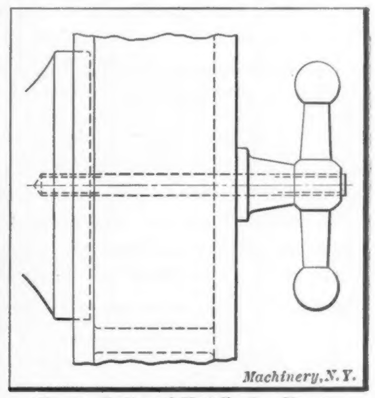


Fig. 6. Bolt and Handle for Clamping Drill Head

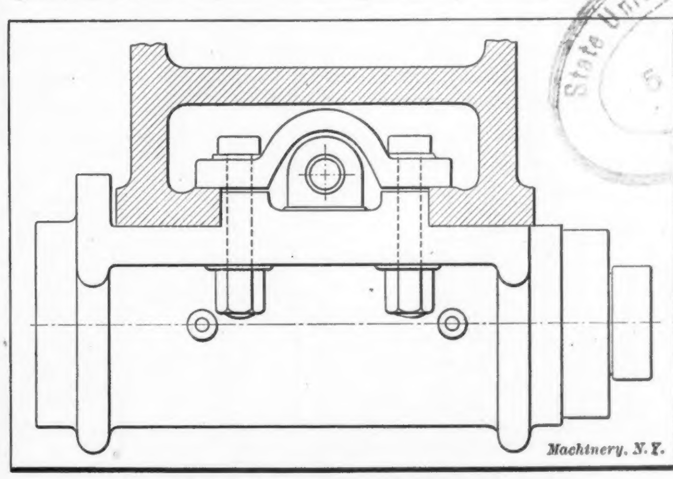


Fig. 7 Showing Use of Bolts and Strap for Clamping

The following selection of typical devices, representative of American, English, and German practice, will serve to illustrate the principles of clamping and locking devices. A large number of other examples, which might be shown, are but modifications of those here selected.

Clamping Devices

Dealing first with clamping, the simplest example is a set-screw pressing upon the portion that has to be secured.

* See MACHINERY, September, 1910: "Machine Stops, Trips and Reversing Mechanisms."

† Address: 45 Sydney Buildings, Bath, England.

This is a cheap device, but is open to objections. On a flat surface it is efficient, but the pressure is too local, and this construction is not adapted to withstand heavy strains without slipping. Moreover it has the bad effect of forcing the parts away from each other when screwed up, so that a fruitful source of vibration is introduced, whereas other and better methods of clamping pull the parts together and act as clamps in the true sense of the word. Usually the pressure of a set-screw point is objectionable, and a soft pad or shoe is employed to avoid the marring effect otherwise met with. This pad or shoe may be shaped to correspond with the form

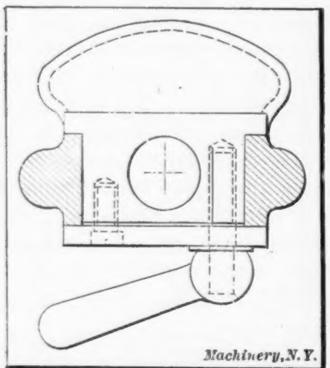


Fig. 8. Clamping Screw Located on One Side

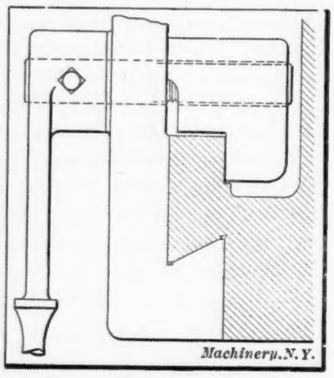


Fig. 9. Clamping Device for Drill Saddle

of the surface against which it bears. Fig. 1 is an example of a set-screw in an awkward situation, this example being taken from one of the Seller's tool-grinders; the screw passes through a bushing, and presses upon a pad shaped to fit the outside of the cylindrical sleeve. In some cases the shoe or pad may be notched out to press against the V of a slide, as

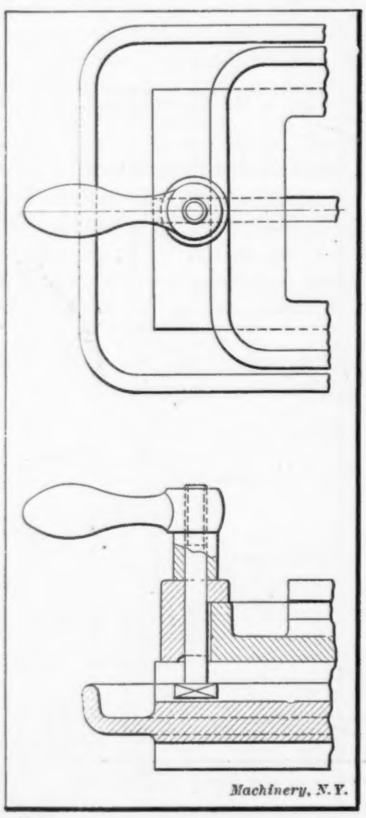


Fig. 10. Clamp for Grinding Machine Swivel Table

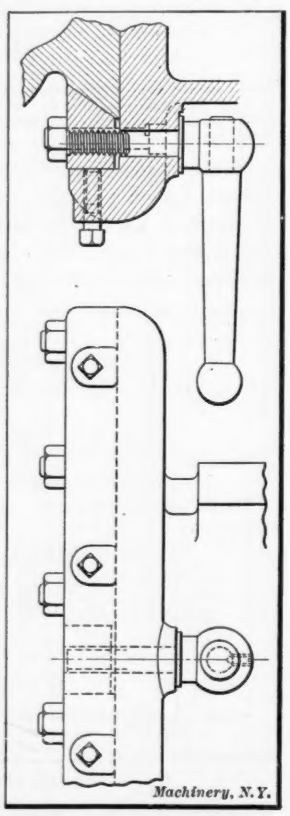


Fig. 11. Clamping Arrangement for V-slide

in Fig. 3, for locking purposes. This example is taken from a cutter-grinder. The necessity for a shoe is sometimes avoided by sinking the end of the screw into the metal, as in Fig. 2, which shows a gib clamp for a milling machine slide. In the case of a circular part, Fig. 4, a groove is turned for the locking screw to enter, this construction also preventing endwise motion of the pin to be locked. The function of the pin is to actuate a clutch for a drilling machine head. Sometimes the groove is arranged so that the screw draws the piece tightly downward to a bearing, as shown in Fig. 5.

There are numerous instances where ordinary bolts are employed for clamping purposes; some special form of clamp or strap is often used in this connection, in order to utilize the pressure to the best advantage. Thus in the work-spindle slide of a gear-cutter, Fig. 7, four bolts are employed, and a

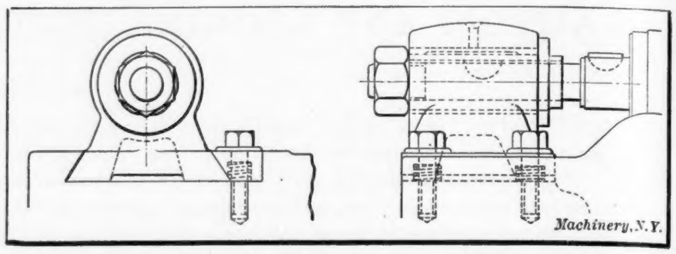


Fig. 12. Clamping Strip with Springs for Raising the Strip when Released

dished clamping plate is used to clear the nut at the back of the slide. When rapid manipulation without using a spanner is desirable, a handle takes the place of the hexagon nut, as on the sensitive drill shown in Fig. 6. Another case

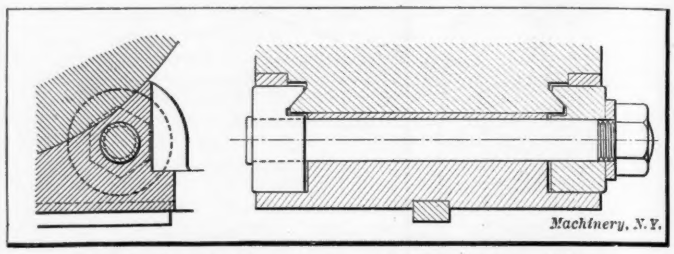


Fig. 13. Clamping Action on Opposite Sides of Swivel-block

where the clamping screw is set to one side, owing to the presence of a central hole, is seen in Fig. 8; a fillister-head screw retains the plate in position on one side, and the tightening of the handle clamps the slide against the face

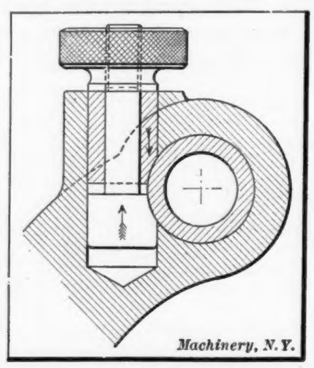


Fig. 14. Clamping with Bolt and Bushing

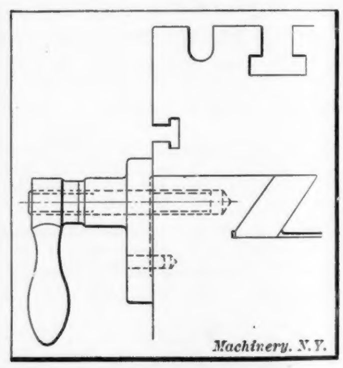


Fig. 15. Clamping Plate for Edge of Milling Machine Table

of the casting. This detail is taken from a cutter-grinding machine. After some time, a clamping handle will assume a position which renders its proper operation difficult, and provision may be made to compensate for wear to prevent this

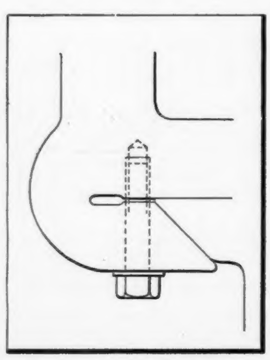


Fig. 16. Clamping Arrangement based on the Spring Action of the Metal

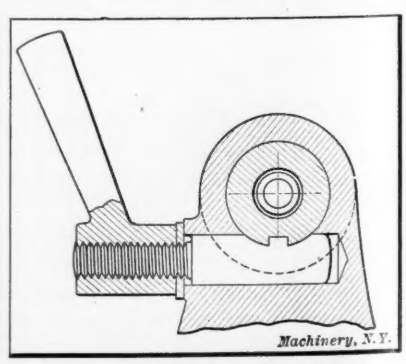


Fig. 17. Clamping Bolt for Poppet or Tailstock Spindle

trouble. Thus, in Fig. 9, the handle turning the screw which pulls the clamping block up is secured by a set-screw. By loosening the latter, the handle can be readjusted into the most convenient position. This particular example represents the clamp for the saddle of a radial drill.

Fig. 10 illustrates the table clamp of a grinding machine, which permits of the swiveling motion for angular grinding. This design differs from the previous instance in that the bolt is adjustable in its slot to allow for the radial movement of the table. Another specimen of clamping with a block drawn up by a bolt and handle is shown in Fig. 11, and is used for a milling machine slide. The threaded end of the bolt is tapped into the block, and the latter presses against the beveled edge of the slide. Another variation of this type

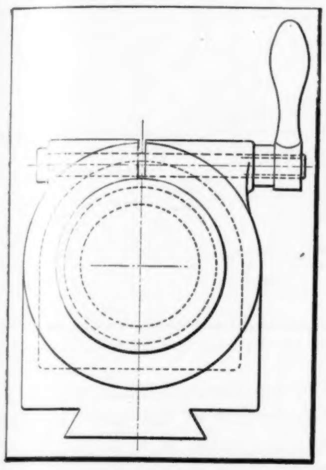


Fig. 18. Method of Clamping with a Split Bracket

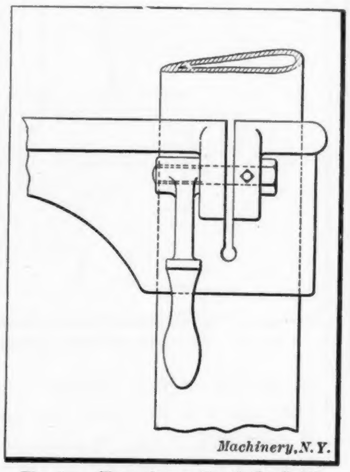


Fig. 19. Clamping a Partially Split Bracket to a Column

of device is shown in Fig. 12, illustrating the outer bearing for a gear-cutter spindle. This spindle must be adjusted endwise; by loosening the two set-screws, the clamping strip is raised by the coiled springs, and the bearing is free to slide. Under certain conditions it is necessary to have a perfectly balanced clamping effort, as, for example, in dividing

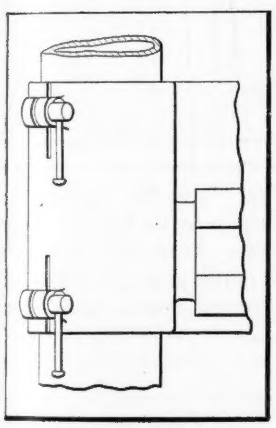


Fig 20. Sleeve Split at Ends for Clamping

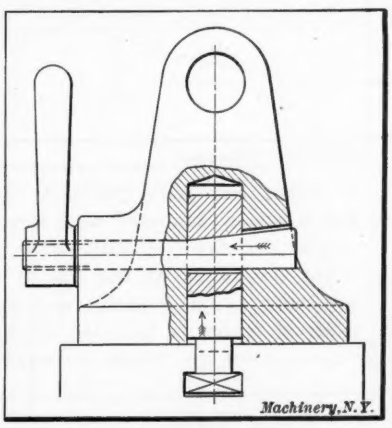


Fig. 21. Example of Wedge Clamping

heads. An instance of this is illustrated in Fig. 13. The swivel-block has beveled edges turned at each side, and the correspondingly shaped blocks are drawn together simultaneously by the tightening of the nut; the clamps are guided in the solid metal, so that distortion is prevented. A similar

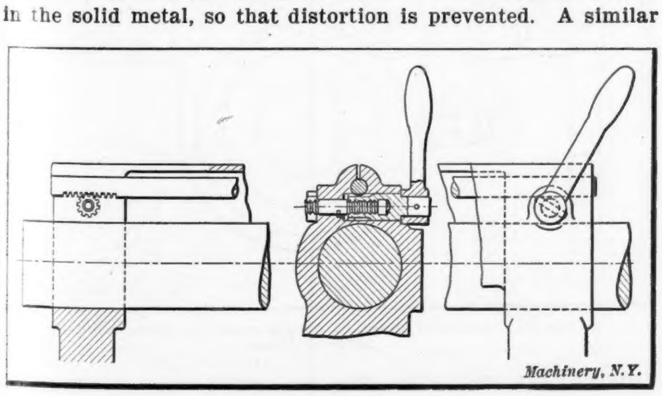


Fig. 22. Clamping Two Bearings simultaneously

principle is employed in many classes of clamping devices for cylindrical parts, such as the spindle in Fig. 14, which is secured by the pressure of the bolt head and the bushing, suitably formed to fit the spindle, and drawn down upon it by tightening the nut. The spindle is not marred, and there is no need of weakening the bearing by splitting it for the purpose of clamping.

Three other types of clamping devices are shown in Figs.

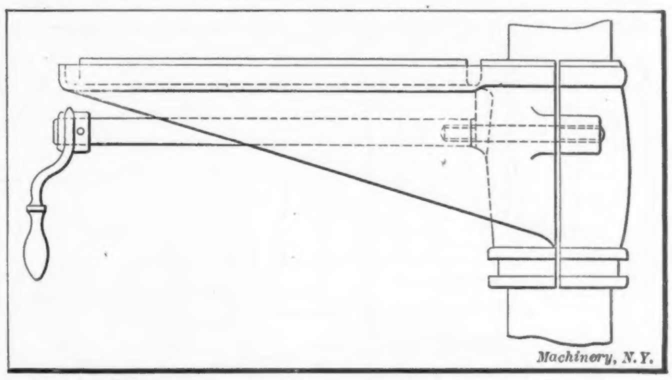


Fig. 23. Clamping Handle carried out to Edge of Table for Convenience of Operation

15, 16, and 17, the first being a plate forced against the side of a milling machine table, this being an alternative construction to that in Fig. 2. Fig. 16 is a form that is only possible in a few cases, the metal being left solid, except for a split or slot, and the clamping effected by its springing action only. This detail shows the method of attaching a milling machine brace to the knee. Fig. 17 shows a clamping arrange-

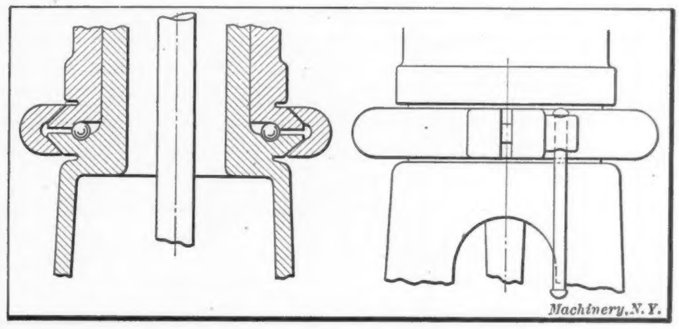


Fig. 24. Clamping Radial Drill Sleeve to Column

ment for a poppet or tailstock spindle, which also serves the purpose of keeping the spindle from turning.

One of the most popular methods of clamping is by the split lug, boss or collar, drawn together by a screw or screws. This provides for a very powerful grip. There are so many examples of this device that it is only possible to show a few types. In small lugs, fillister-head screws are suitable for the drawing-together action, but a bolt is better for large parts, as in Fig. 18, which shows the bracket of a cutter-grinder

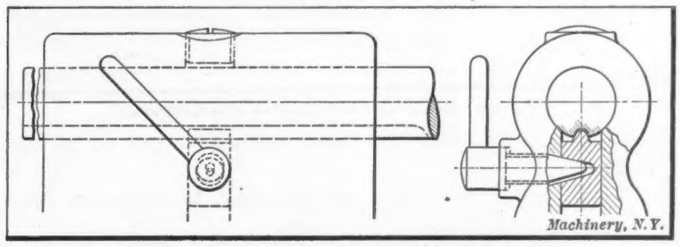


Fig. 25. Wedge Action Clamp for Grinder Tailstock

clamped on its pillar. It is not always necessary to carry the split right through the boss; it may only pass partly through, as in Fig. 19. The bolt in this case is held by a set-screw, so that it may be turned partly around to bring the clamping handle into the most convenient position, this constituting a variation of the method in Fig. 9. Fig. 20 is another instance of partial splitting of a sleeve of a radial drill arm. An interesting type of such a method of clamping is found in the Brown & Sharpe milling machine arm; the two tightening screws are situated at the opposite ends of the frame, but are coupled together by a rack-bar which causes the two screws to turn simultaneously. It is, therefore, necessary to turn one screw only, as indicated in Fig. 22.

The tightening nut or lever for a split clamp is usually

placed close to the boss, but in some cases it may be necessary to vary the position for convenience of manipulation. Thus in the drilling machine table, Fig. 23, the screw is prolonged into a long spindle, thus bringing the clamping handle to the front of the table, where the operator can reach

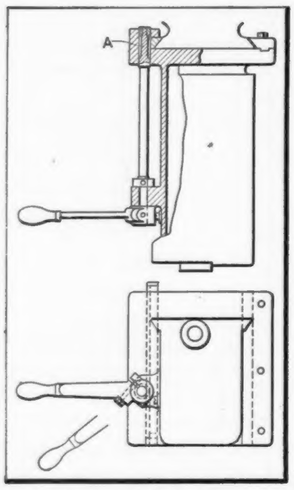


Fig. 26. Long Strip for Clamping Knee of Milling Machine

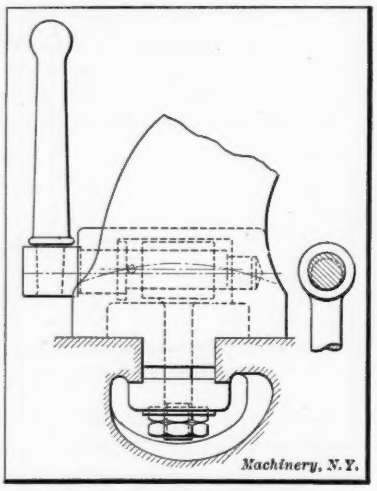


Fig. 27. Eccentric Clamp for Tailstock

it without effort or straining. Fig. 24 illustrates a split clamp which does not act in the usual manner, but serves

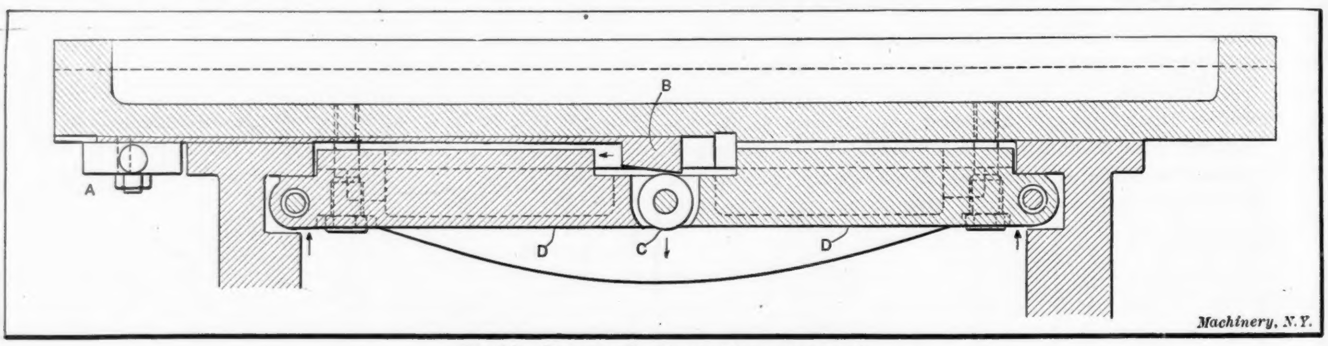


Fig. 28. Clamping Device for Planer Cross-rail

to draw two beveled surfaces together (this example being a pillar and sleeve of a radial drill), to prevent rotation. When

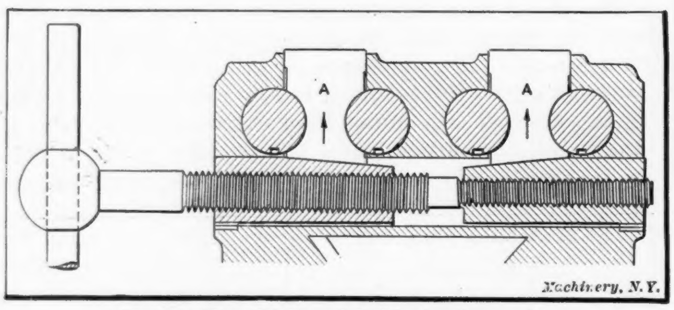


Fig. 29. Clamping Four Spindles simultaneously

the clamp is loosened, the sleeve is free to turn on its ball-race.

Wedge action is utilized for clamping, in numerous cases,

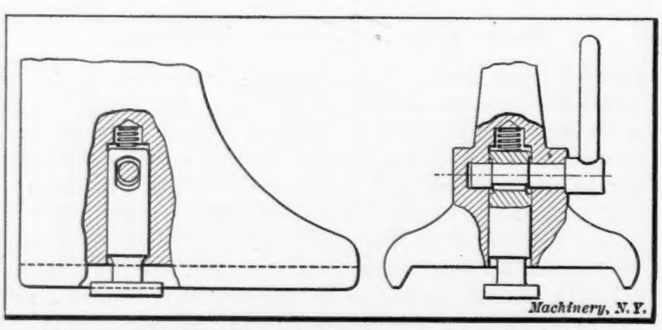


Fig. 30. Eccentric Action Clamping Device used on Bench Lathe

instead of direct screw pressure, and is often more suitable for certain purposes. Fig. 21 is representative of several such designs, this example being the clamp for a grinder ta'lstock; the action is like that of a cotter. A similar principle is employed in Fig. 25 where the overhanging arm of a special grinding machine is held by the forcing upward of a block through the screwing in of a tapered plug. The groove in the arm also prevents the latter from twisting.

Fig. 26 shows the principle of a clamping arrangement used

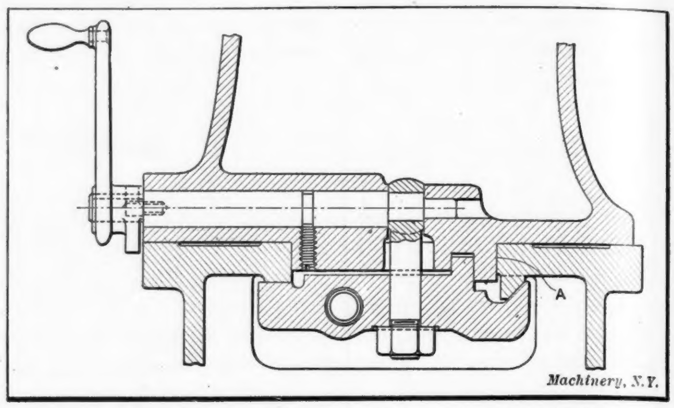


Fig. 31. Eccentric Action Clamping Device used on Chucking Lathe

by Messrs. Alfred Herbert, Ltd., on their milling machines. The object is to clamp the entire length of the knee, instead of clamping at one location only, the wedge strip being forced downward by turning the handle, which causes the pinion *A* to rotate and force the strip along. Another instance of wedge action combined with levers, is seen in Fig. 28, which shows the Whitcomb-Blaisdell planer cross-rail fastening. When the handle in the disk *A* is pulled over, it draws the strip and wedge *B* along, and the latter presses against the roller *C*, which is mounted on the pivot pin of the levers *D*. These levers are forced outward, and as they pivot on the

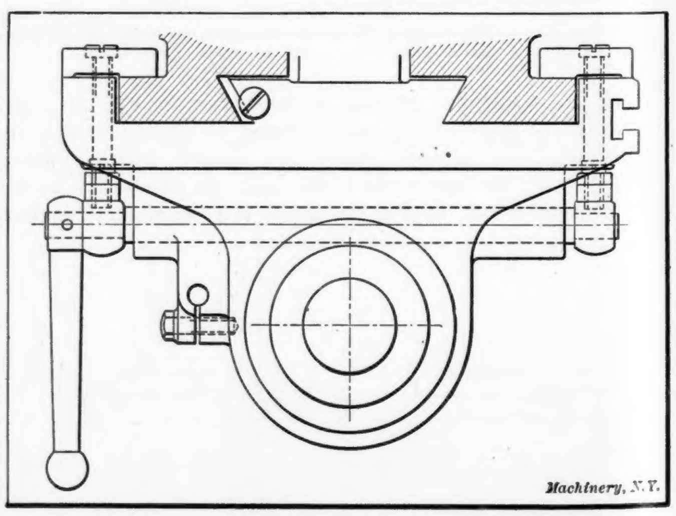


Fig. 32. Eccentric Clamping Arrangement for Vertical Milling Machine Head

screws near their ends, they are caused to press against the inside of the uprights, and thus pull the cross-rail tightly against the faces of the housings. Fig. 29 shows a multiple clamping arrangement, used on multiple dividing centers. The object is to bind the four spindles simultaneously. When the right- and left-hand screw is turned, it draws the two wedges

together, and these push the blocks A upward, thus binding the spindles.

Eccentric action is also employed extensively, and has the advantage of being more rapid and convenient for some

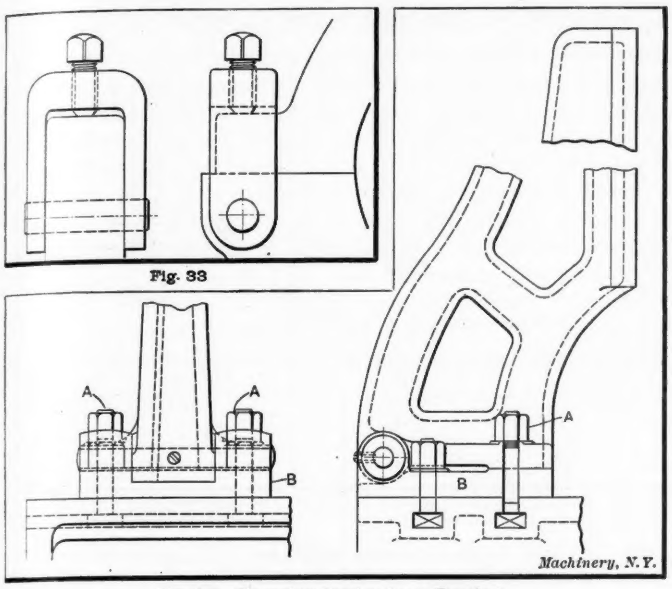


Fig. 33

Fig. 34. Clamping Device for a Bracket

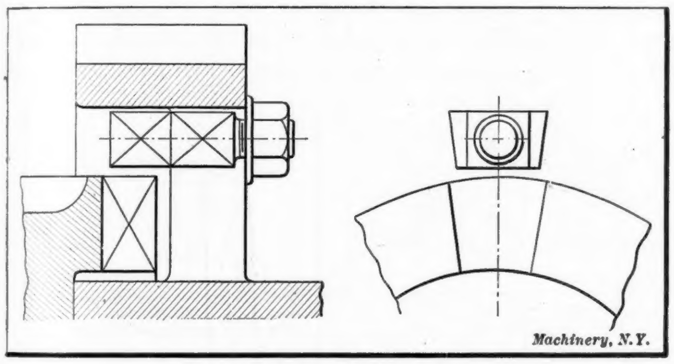


Fig. 35. Locking Pin for Lathe-head Gears

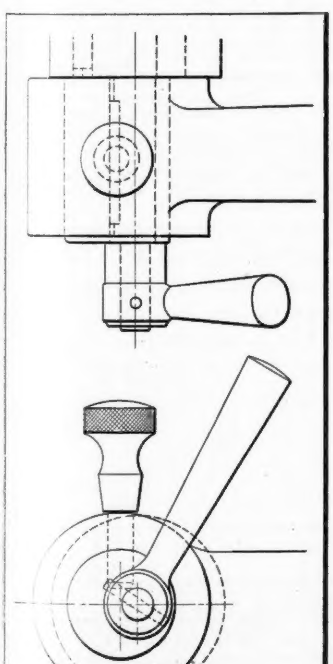


Fig. 36. Eccentric Spindle Locking Pin

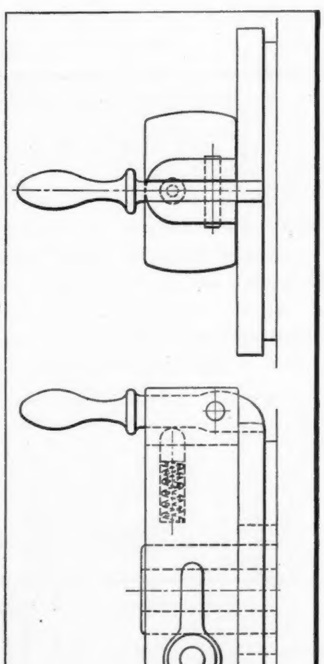


Fig. 37. Locking Arrangement for Indexing Lever

kinds of clamping than a screw or wedge. This action is particularly handy when the clamping and unclamping is very frequent. An eccentric device applied to a lathe tailstock is illustrated in Fig. 27. The nuts at the bottom of the clamping plate allow for adjustment to make the eccentric act at the proper position of the handle. A modified form of the same type is seen in Fig. 30, which is used for a bench lathe, while an arrangement for the turret saddle of a chucking lathe is shown in Fig. 31. The clamping plate here is designed to pull the saddle over against the edge A of the bed, so that a constant alignment is preserved. The tightening lever has stop lugs, which abut against studs, screwed into the face adjacent to the boss, and arrest the lever

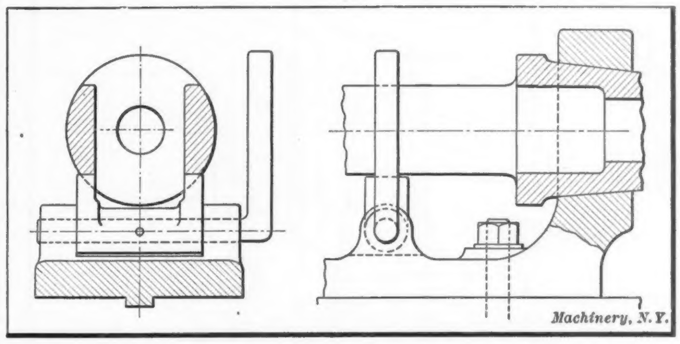


Fig. 38. Lock for Open Spindle of John Lang & Sons Turret Lathe

at definite positions. An instance of duplex clamping, applied to the head of a vertical milling machine, is shown in Fig. 32. The clamping rod passing through the casting has slightly eccentric ends, and these force the lugs upon them in an outward direction when the lever is pulled, thus drawing the plates or clamping strips against the back edges of

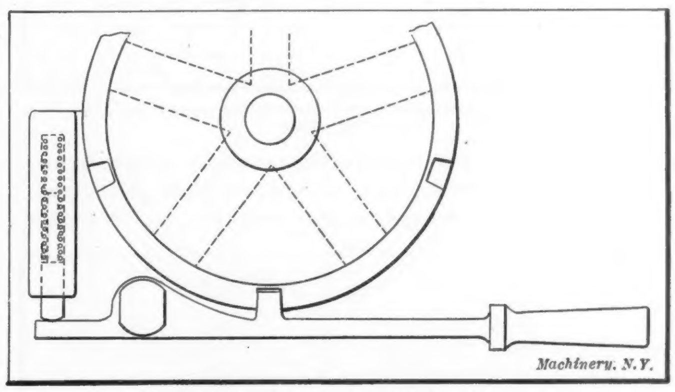


Fig. 39. Locking Turret with External Lever

the projecting ways of the column. Adjustment is made by means of the threaded ends and the nuts.

Provision has occasionally to be included for permitting a pivoting or "throw-back" action in connection with clamping. Very frequently a pivoted eye-bolt meets the requirements, or alternatively a loop or strap fitted, as shown in

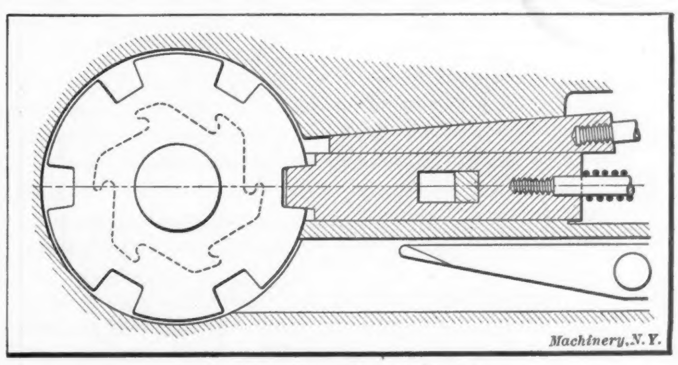


Fig. 40. Plunger Lock for Turret

Fig. 33, to a hinged steady-rest. A different method is to employ bolts in T slots, Fig. 34, the two marked A being used to hold the bracket down, for steadying the arbor support of a gear-cutter. The bracket is hinged on the pivot-pin in the plate B, and the latter remains clamped in position by its two bolts. When the bracket has to be thrown back, it is only necessary to slacken the nuts A, and slide the bolts out of the slots. Another point with reference to

clamping is that power is sometimes gained by using gears for effecting a specially tight grip. There is one type of lathe tailstock in which the clamping bolt is turned by a spur gear actuated by a pinion, on the shaft of which the spanner is placed, thus giving a very powerful grip for high-speed work.

Locking Devices

Taking up now the consideration of locking devices, it should be mentioned that these may be classified as positive locks

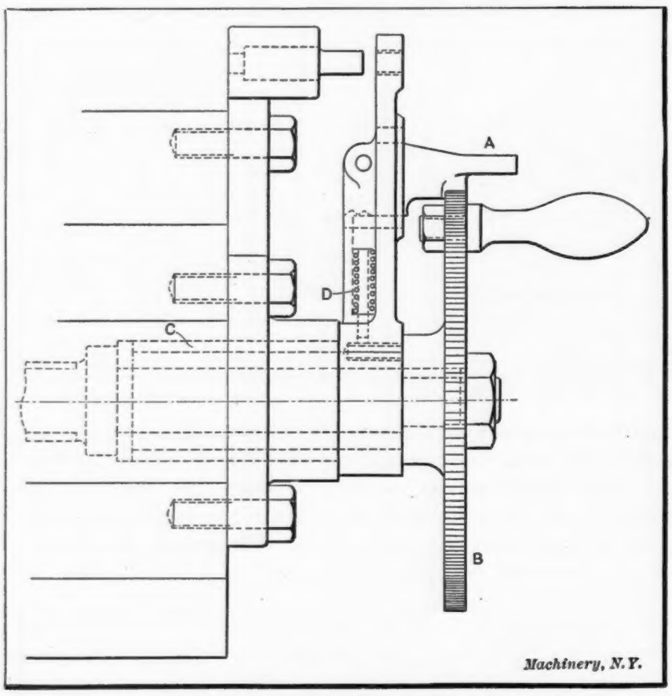


Fig. 41. Locking Arrangement for Quick Withdrawal Device on Threading Lathe

and friction locks, the latter being obviously unsatisfactory in many cases where the risk of any slip would be detrimental. The simplest lock, perhaps, is that used for the back-gears

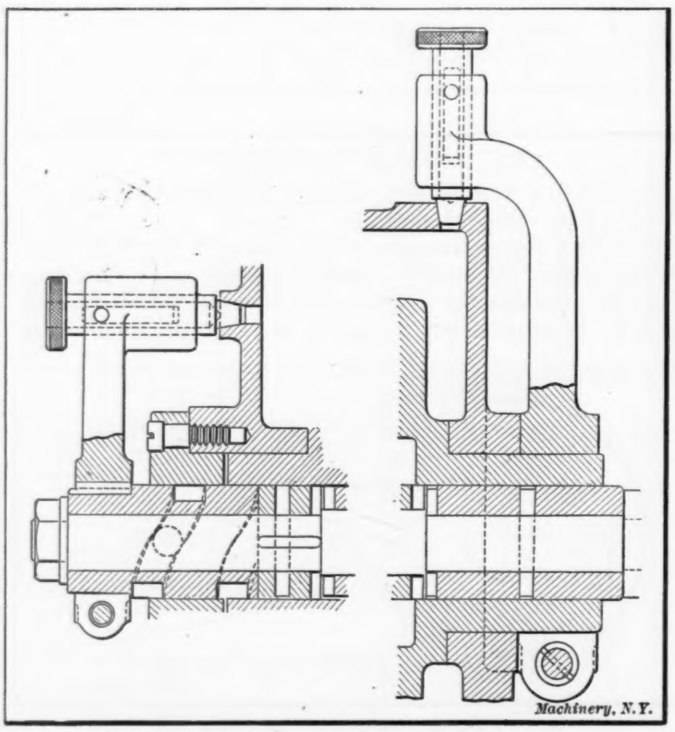


Fig. 42. Locking Plungers with Knobs for Withdrawal

of a lathe or other machine, where a bolt is slid into a slot to encounter a projection on the cone pulley. The pin may also be pushed endwise into a hole, the relative positions of in- and out-of-gear being controlled by a spring. This kind of device is also employed to lock the pulleys of grinding heads when dead-center work is being done. Fig. 35 represents a lock adopted on a high-speed lathe, the locking bolt being tapered to fit in the slot in the adjacent gear, the object being to prevent back-lash. A typical positive lock is shown in Fig. 36, this example being the pin for securing the eccentric spindle of a back-gear. The pin may be straight or parallel, as shown, but more frequently it is tapered. Slides or other parts are frequently locked by tapered pins.

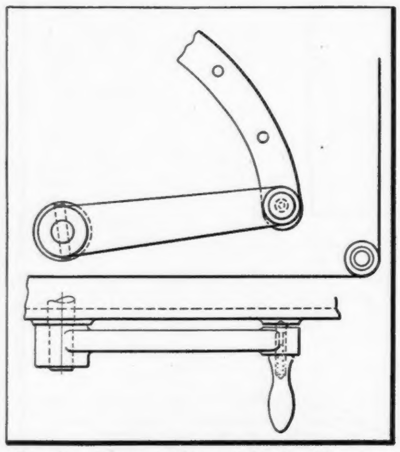


Fig. 43. Common Type of Spring Plunger for Locking Lever

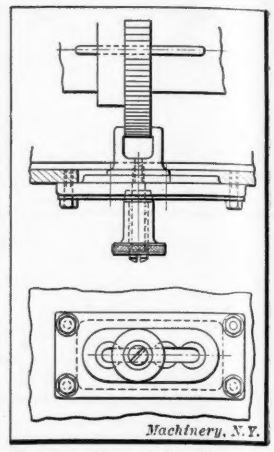


Fig. 44. Plunger Locking Arrangement for Gear Box

Fig. 38 is a locking device employed on the open-spindle turret lathes of Messrs. John Lang & Sons, to hold the spindle while the chuck on the nose is being tightened or loosened with a spanner. When the lock is thrown downward, the spindle is free to rotate. Two other positive locks are illustrated in Figs. 39 and 40, one for a turret lathe of

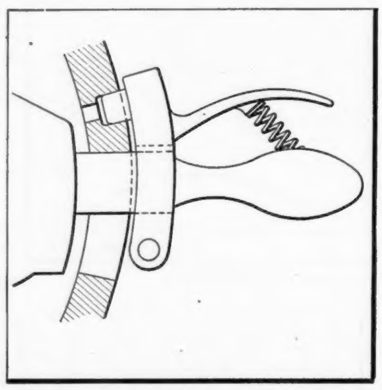


Fig. 45. Withdrawing and Locking Device on Change-gear Box

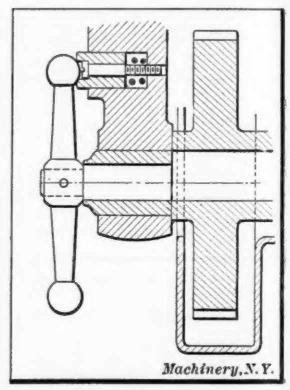


Fig. 46. Spring Lock for Back-gear Lever

the type used largely in England, the other for a central-hole type of turret. In both cases a tapered part enters slots in the periphery of the indexing disks. The wedge strip beside the plunger in Fig. 40 takes up play due to wear.

Positive locks are also seen in Figs. 37 and 41. In Fig. 37 a disk on the body of a sleeve has notches, into any one of which the pivoted catch drops, under the action of a coiled spring, thus holding the sleeve in one position. Fig. 41 shows a quick-withdrawing device for screw-cutting; when

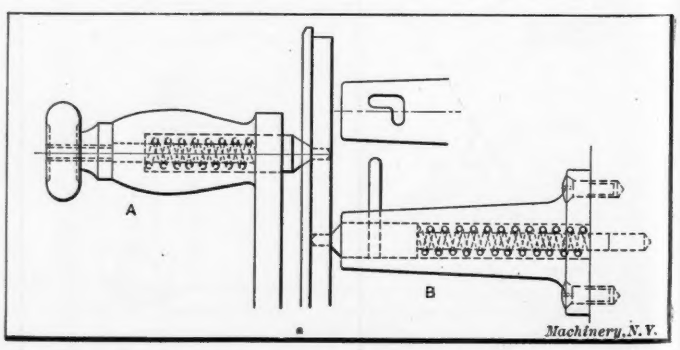


Fig. 47. Locking Plungers for Index Plate and Lever

the catch *A* drops into engagement with the toothed disk *B* the rotation of the latter has the effect of turning the quick-pitched screw *C*. The spring plunger *D* in the lever which carries *A*, locks the latter in either the "in" or "out" position, according to whether the plunger point slips into either the

one or the other of the countersinks in the inner end of *A*.

The spring plunger is a familiar locking device, and is found in varied forms, usually embodying a pointed or tapered plunger which obviates back-lash. A common instance is that shown in Fig. 43, used for a speed- or feed-change lever. The plunger is contained within the handle, and its point slips into any one of the countersinks in the quadrant. The arrangement may also be as in Fig. 42, with a pull-back device for each plunger, as the latter in this case enter more deeply into their locking holes. An alternative construction is shown in Fig. 44, where the block which moves or slides the spur gears endwise is locked by a tapered sleeve entering any one of four tapered recesses in the locking plate. A spring inside the sleeve keeps it in position. Fig. 45 illustrates another method of withdrawing a plunger, this method being used on the familiar Hendey-Norton change-gear device, in which the act of grasping the handle firmly withdraws the plunger, ready for the movement to another hole. Still another method, employed on a milling machine divid-

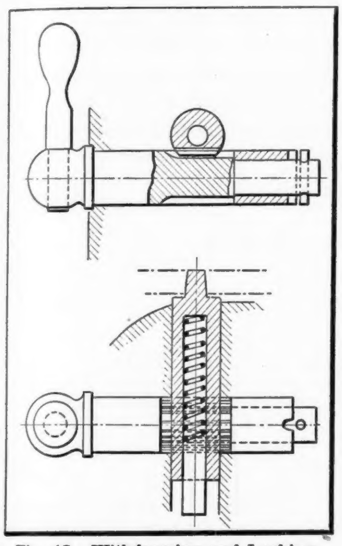


Fig. 48. Withdrawing and Locking Device for Spring Plunger

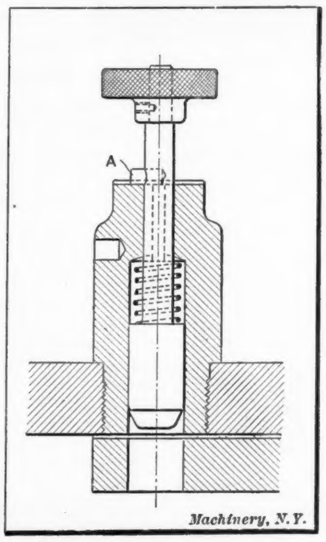


Fig. 49. Locking Plunger with Locking Pin

ing head is represented in Fig. 48; the locking plunger in this example is pulled back by a rack and pinion device, and the pinion sleeve is itself locked by drawing it backward until the pin near its end slips into the slot in a bushing as shown.

Fig. 47 shows a different construction, also for a dividing head; the plunger *A* has only a pull-back action, without a positive lock, while the other plunger *B* is provided with a pin which slips into a sort of bayonet catch, and prevents the plunger from moving forward under the action of the spring.

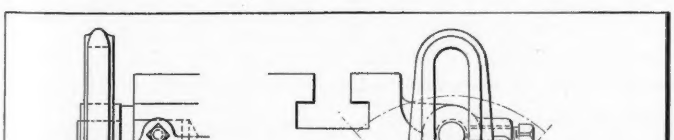


Fig. 50. Cross-slide Lever with Split Hub for Locking in Various Positions

The locking plunger in Fig. 49 (for coupling in the back-gears of a vertical milling machine), is held out of position by the pin *A*, but a quarter turn of the plunger allows this pin to slip into a groove inside the bore and thus let the plunger into any one of the holes in the disk below. Finally, the Brown and Sharpe back-gear lock, Fig. 46, represents an ingenious method of retaining automatically the ball ends of a lever in position.

The succeeding illustrations are those of friction locking devices. Fig. 50 might be classed as a clamping device, but as its only purpose is to allow of locking in different positions, it should logically be classed in the latter category. The split handle or lever is employed to work the cross-slide of a turret lathe. In order that the operator may have the handle in the most convenient and least fatiguing position, it is adjustable around the pin on which it is mounted, by simply loosening the binding screw. An alternative method

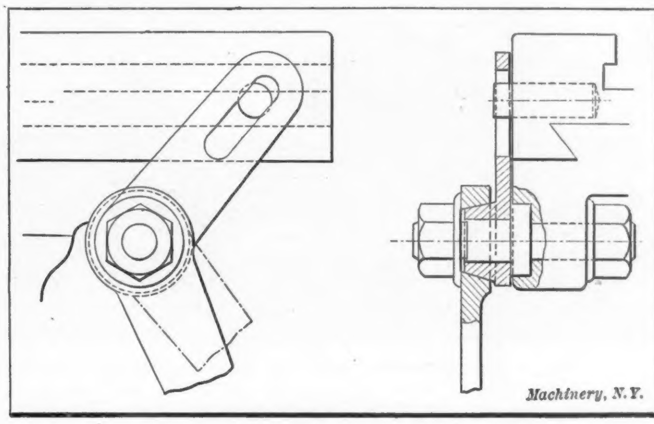


Fig. 51. Cross-slide Lever with Friction Lock

is to taper the inside of the lever, as in Fig. 51, to match the outside of the slotted levers shown, and force the two together by a nut. This constitutes a friction clutch, and is an idea that is found in many locking devices, especially for locking gears and other parts together temporarily, and for micrometer and similar devices. Other arrangements for micrometer dials are shown in Figs. 52 and 53, for locking the dials at zero when desired. Fig. 52 has a small bolt tightened by a knurled-head nut, the head of the bolt lying in a circular T-slot in the dial. When the nut is screwed up, the dial is locked to the handwheel and turns with it. In Fig.

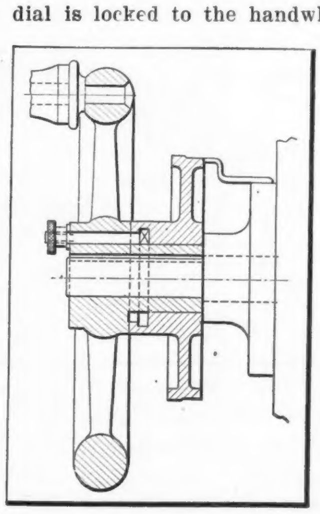


Fig. 52. T-bolt Friction Lock for Micrometer Dial

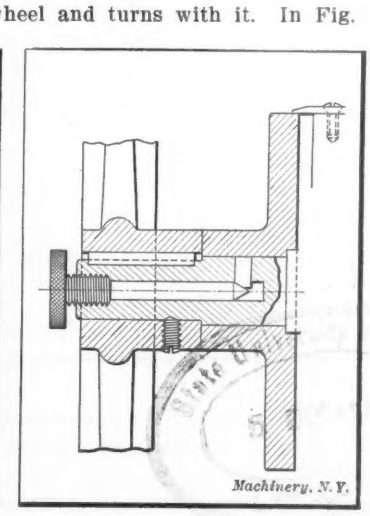


Fig. 53. Pin Friction Lock for Micrometer Dial

53 the point of the central threaded plunger forces a small block outward against the bore of the dial, and locks the latter.

Ratchets are occasionally utilized for locking purposes, one instance being in wire-feeds, where the feeding dog is held on its supporting rod by a pawl entering into the teeth of the ratchet bar.

* * *

In an address before the Hartford Manufacturers' Association, Mr. B. M. W. Hanson of the Pratt & Whitney Co. deplored the fact that there does not seem to be any unity of action throughout the country to educate more mechanics in a systematic way, and said that too little thought had been given to make the machine shops attractive to the American boy. One of the chief reasons, he believed, is that the wages offered to an apprentice boy under modern conditions are entirely too low, and that the labor supply is more often obtained from the immigrant office and the street than from the graduating class of the public schools.

ENGLISH 24-INCH LATHE

By W. H. HAGGAS*

The 24-inch lathe illustrated in the accompanying halftones and line engravings is made by Messrs. Ward, Haggas and Smith, Eastwood Tool Works, Keighley, and its new and im-

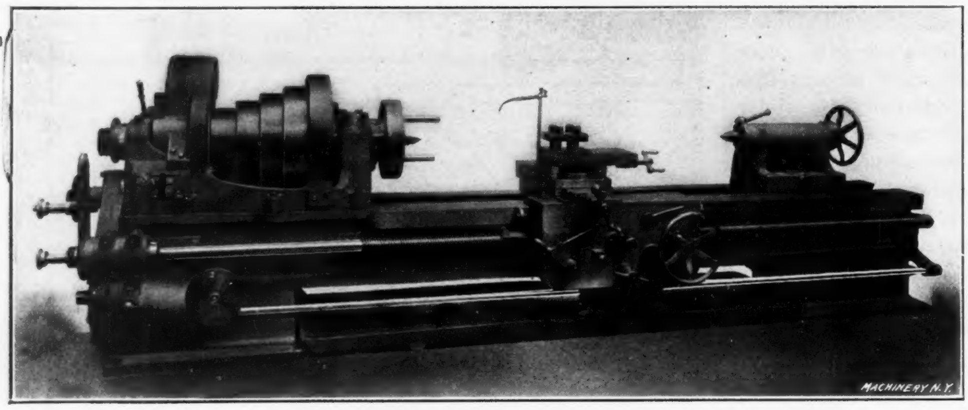


Fig. 1. Twenty-four-inch Lathe, built by Ward, Haggas & Smith, Keighley, England

portant features are patented in England and the Colonies. It is a good example of modern English lathe design, and possesses many interesting features, chief of which is the

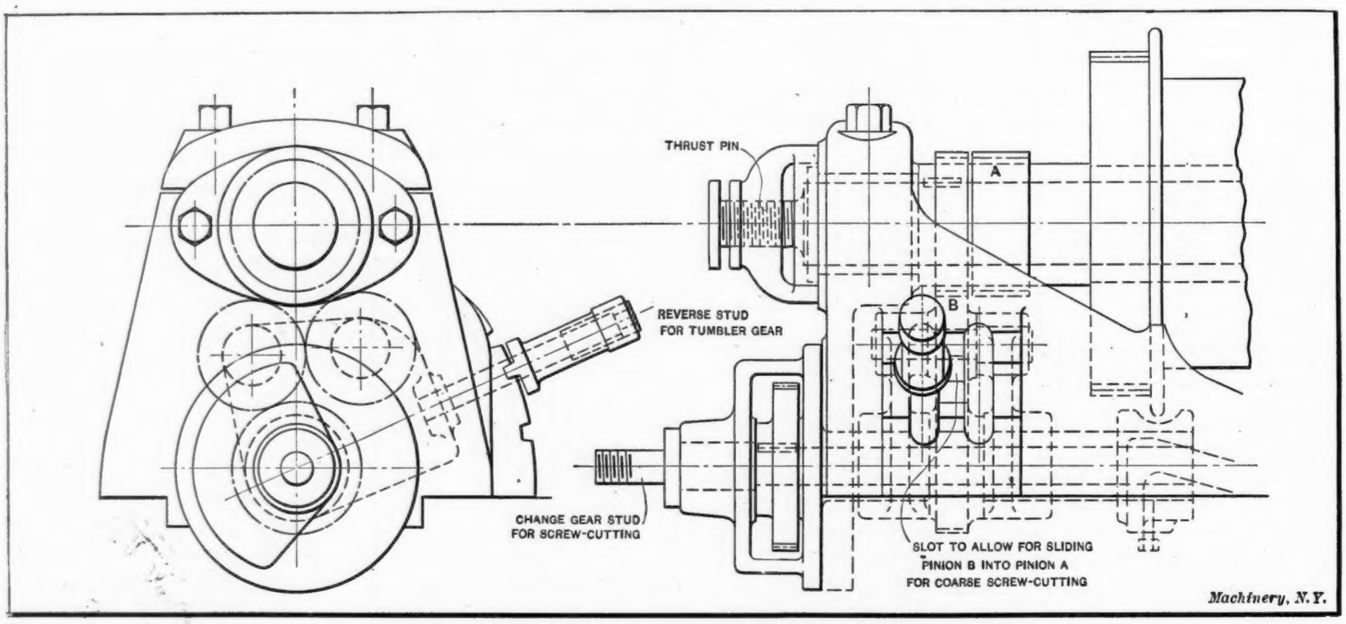


Fig. 2. End and Side Elevations of Left-hand End of Headstock

method of gearing the lead-screw to the drive.† The halftone, Fig. 1, gives a good general idea of the design of the machine.

The headstock has a four-step cone, the diameter of the largest step being 18 inches. The driving belt is 4 inches wide. Two ratios of back-gearing are provided, being 4 to 1 and 16 to 1, respectively, thus providing for twelve spindle speeds from a one-speed countershaft; by means of a two-speed countershaft twenty-four speeds can thus be obtained. The countershaft speeds are so selected that two consecutive speeds can be obtained on the same step of the driving cone pulley by simply shifting the countershaft speed. The total speed ratio is 45 to 1, the ratio between any two speeds with a one-speed countershaft being 1.4 to 1.

The feed-rod and lead-screw are reversed by the handle shown at the left end of the head in Figs. 1 and 2. It will be seen that there are two slots for the reverse handle, connected by a cross-slot. The object of this is to make it possible to engage gears either with a gear keyed to the spindle or to the cone pinion, as indicated in Fig. 2. Hence the cone gear can be used directly for driving the change gears in certain cases, and in this way three different pitches of screw threads can be cut with the same change gears. For example, suppose that the lathe is geared for cutting a screw of one-inch pitch, when the tumbler gear is engaged with the gear on the spindle. By shifting the lever so that the tumbler gear engages with the cone gear, we would cut a 4-inch or 16-inch pitch screw, according to which set of back-gears was thrown in. Hence it is apparent that the size of the change gears can be kept within reasonable limits with this arrangement and yet screws of unusual lead can be cut. In fact, a screw of 26 inch lead has been cut on a lathe of this type without difficulty. It is also possible to remove more metal per hour by a double back-geared lathe than is possible with a lathe using a much larger cone and single back-gearing, and the belt is much easier for the operator to handle.

The bed is of a complete box section as will be seen from Fig. 4, making it from four to twelve times as strong to resist twisting moments as an ordinary lathe bed section of the girder type. Holes are provided in the bed for the chips to drop through, and in addition the bed is provided with some features of especial value, the principal ones of which are the front or "narrow" guide for the carriage, and the locking arrangement for the tailstock, both of which features are protected by patents. It will be seen that the front or narrow guide is entirely removed from chips and dirt and

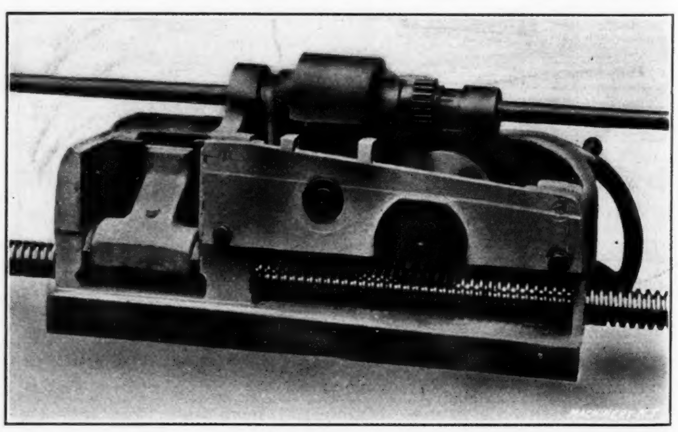


Fig. 3. View of Apron Upside-down and Reversed, showing Construction

that it is directly over the lead-screw and feed-shaft, hence eliminating any tendency of cross binding in the carriage. It may be mentioned, as illustrating how freely the carriage moves, that in the 16-inch lathe of the same type as that il-

* Address: 26 Ashleigh St., Keighley, York, England.
† This feature is not new, however, as such an arrangement was used on a Putnam lathe many years ago.—EDITOR.

lustrated, the carriage can be pushed along the bed by hand when under working condition.

Fig. 4 shows how the locking of the tailstock on the bed is effected. When the bolts are tightened the bracket is drawn up on the beveled surface and clamps the tailstock securely. The base of the tailstock is so arranged that it is always drawn tightly against the back square edge of the bed, which is subjected to no other wear, thus securing permanency of alignment with the headstock. In the ordinary English lathe, as well as in many lathes of other than English construction, the tailstock is fitted between the ways of the bed and hence the locating surfaces are subjected to a considerable amount of wear as the head is moved along the bed. The tailstock in the lathe described is provided with a side adjustment for taper turning, as shown.

Since the carriage, as stated before, is provided with a guide in the front, the usual back-wing for the carriage is unnecessary. It is rigid under the heaviest cut, the headstock being set well back so that the strain of the cut falls entirely within the bed. Six rates of feed are provided—4, 8, 12, 16, 24 and 48 per

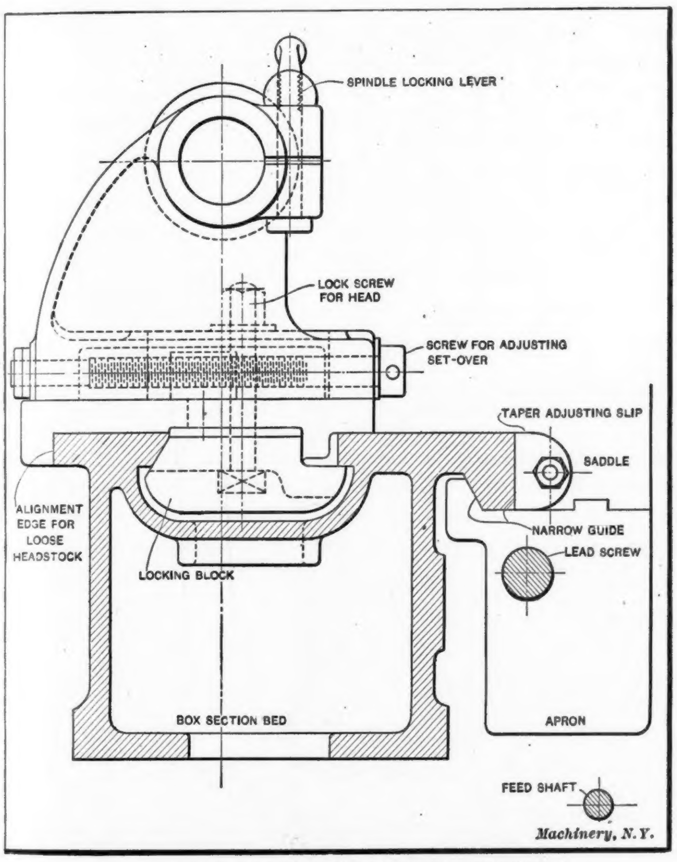


Fig. 4. Section of Bed and End Elevation of Tailstock

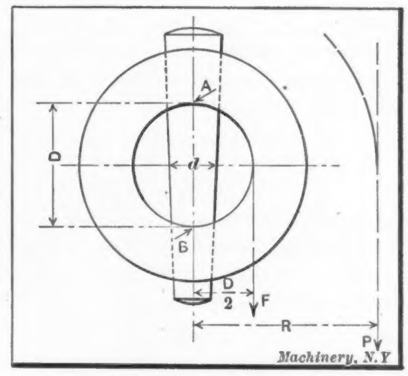
inch—which are obtained through a feed gear-box. This gear-box has a spring key operated by the handle on the dial, and a double gear operated by a small handle, both of which are shown in Fig. 1. The feeds are engaged from the apron by means of a knob shown near the screw-cutting handle. The knob is connected with a drop worm running in an oil bath, the thrust of the worm being taken by ball thrust washers. As shown in Fig. 3, the shafts in the apron have a double bearing. The lead-screw and feed-rod can be engaged at will, and the machine is, of course, so designed that they cannot both be in gear at the same time.

The following examples of work that can be done on this lathe under ordinary working conditions may be of interest. The figures have been supplied by one of the customers of the builders. A steel shaft, 0.25 per cent. carbon, 6 inches in diameter, was reduced to 5⅜ inches with a cutting speed of 60 feet per minute and a feed of ¼ inch per revolution. The reduction in weight per minute was 11.3 pounds. A shaft 5⅜ inches in diameter was reduced to 4½ inches with a cutting speed of 81 feet per minute; the feed per revolution was 1/12 inch, and the reduction in weight was 7.7 pounds per minute.

SHEARING STRENGTH OF TAPERED PINS

By J. H. C.

Frequently in using tapered pins the shearing strength must be looked into. The following shows the derivation of formulas necessary to do this. These formulas are found in convenient terms and may be useful to those using this style of pin.



Shearing Strength of Tapered Pins

In the illustration the external force F, tending to shear the pin at points A and B is $\dfrac{2\,PR}{D}$

$$\text{For } PR = \frac{FD}{2} \text{ or } F = \frac{2\,PR}{D}$$

and the internal force $= 2\ (0.7854d^2 S)$ where $S =$ unit working stress.

Equating internal and external forces.

$$\frac{2\,PR}{D} = 2 \times 0.7854d^2\,S$$

$$\text{or } S = \frac{1.27\,PR}{Dd^2} \qquad (1)$$

$$\text{and } d = 1.13\sqrt{\frac{PR}{DS}} \qquad (2)$$

(1) and (2) being formulas in terms of resisting moment, D and S.

Number of horsepower (HP) transmitted around circle of R radius equals $\dfrac{\text{foot-pounds per minute}}{33000}$.

Number of foot-pounds transmitted around circle of R radius equals $P\,\dfrac{2\,\pi\,R}{12}\,N$

where $N =$ revolutions per minute or $HP = \dfrac{PR\,\pi\,N}{6 \times 33000}$

$$PR = \frac{6 \times 33000\,HP}{\pi\,N} = \frac{63025\,HP}{N}$$

Substituting in (1) and (2)

$$S = \frac{1.27}{Dd^2} \times \frac{63025\ HP}{N}$$

$$\text{or } S = \frac{80000\ HP}{NDd^2} \text{ (nearly)} \qquad (3)$$

$$\text{and } d = 283\sqrt{\frac{HP}{NDS}} \qquad (4)$$

formulas (3) and (4) being in terms of horsepower transmitted, N, S and D.

Examples

1. A lever secured to a 2-inch round shaft by a steel tapered pin, whose dimension $d = 3/8$ inch, has a pull of 50 pounds at a 30-inch radius from shaft center. To find S, the unit working stress on the pin, substituting numerical values in formula (1)

$$S = \frac{1.27\,PR}{Dd^2} = \frac{1.27 \times 50 \times 30}{2 \times (\frac{3}{8})^2} = 6773$$

pounds per square inch (nearly) which is a safe unit working stress for machine steel in shear.

2. Again as in the above, let $P = 50$ pounds, $R = 30$ inches, $D = 2$ inches and $S = 6000$ pounds unit working stress. Using formula (2) to find d

$$d = 1.13\sqrt{\frac{PR}{DS}} = 1.13\sqrt{\frac{50 \times 30}{2 \times 6000}} = 1.13\sqrt{\frac{1}{8}} =$$

0.4 inch diameter (nearly). Say $d = \frac{3}{8}$ inch.

3. A ½ horsepower motor pinion meshes into a gear wheel running at 100 revolutions per minute. A tapered pin whose d dimension equals ¼ inch, passes through the gear and a 1-inch round shaft. To find S, the unit working stress, using formula (3)

$$S = \frac{80000\,HP}{NDd^2} = \frac{80000 \times (\frac{1}{2})}{100 \times 1 \times (\frac{1}{4})^2} = 6400$$

pounds per square inch, unit working stress.

4. Using the same conditions to find the average diameter of pin, with a working unit stress S, equal to 6000 pounds, using formula (4),

$$d = 283\sqrt{\frac{HP}{NDS}} = 283\sqrt{\frac{\frac{1}{2}}{100 \times 1 \times 6000}} =$$

$$283\sqrt{\frac{1}{1{,}200{,}000}} = 0.258. \text{ Say } d = \tfrac{1}{4} \text{ inch.}$$

* * *

INDUSTRIAL ACCIDENTS AND EMPLOYERS' LIABILITY

In an editorial comment on industrial accidents, the *Practical Engineer*, London, in its issue of October 28, states that the average annual expense per capita in the metal trades in England for an efficient system of insurance against accidents has been estimated at about one-half cent a day, or a trifle more. It is also mentioned that a satisfactory feature of the working of the law in Great Britain has been the increase of the number of compensation disputes settled out of court, the compensation having been arranged directly between the parties interested in accordance with the law, thus avoiding delay and saving the expense of litigation. The primary principle upon which employers' liability laws rest is, of course, that the particular industry in which any accident occurs should bear the financial responsibility of the accident. It is not intended that the employer personally is to bear the expense, nor will the enforcement of the law work out in practice in that way. It is the industry as such, not the employer, that will bear the expense.

In this connection it is of interest to note the opinion stated by Mr. W. B. Dickson, first vice-president of the United States Steel Corporation, in a paper entitled "The Betterment of Labor Conditions in the Steel Industry," which paper was read before the American Iron and Steel Institute in New York City. "Personally," said Mr. Dickson, "I believe that compensation to injured workmen is a legitimate charge against the cost of manufacture, and that the victim of an industrial accident, or his dependents, should receive compensation, not as an act of grace on the part of his employer, but as a right."

* * *

Some of the smaller European towns of economical habits, says the *Scientific American*, have been complaining because they are obliged to light their streets all night for the benefit of a few belated citizens, and have been trying to discover a method whereby the citizen who needs to have his pathway lighted in the small hours of the night shall pay the costs himself. On one of the streets of a small German town, such a system has actually been put into operation. The street is a little over half a mile long, and is provided with nine lamps. At each end of the street is a penny-in-the-slot machine, and whenever anyone wishes to light up the street, he has merely to drop in a ten-pfennig piece (2½ cents), which turns on the current for twelve minutes. This allows him ample time (in the majority of cases, we presume) to walk the length of the street. The street is normally lighted until 10 o'clock. Thereafter the prepayment meter must be resorted to.

* * *

When you think you are at the top of the ladder in your trade, don't stop self-satisfied—just holler for more ladder.

THE RAVIGNEAUX MANOGRAPH

By W. F. BRADLEY*

There are some distinctive features in the manograph designed by M. Ravigneaux for testing internal combustion motors. Communication between the cylinder under test and

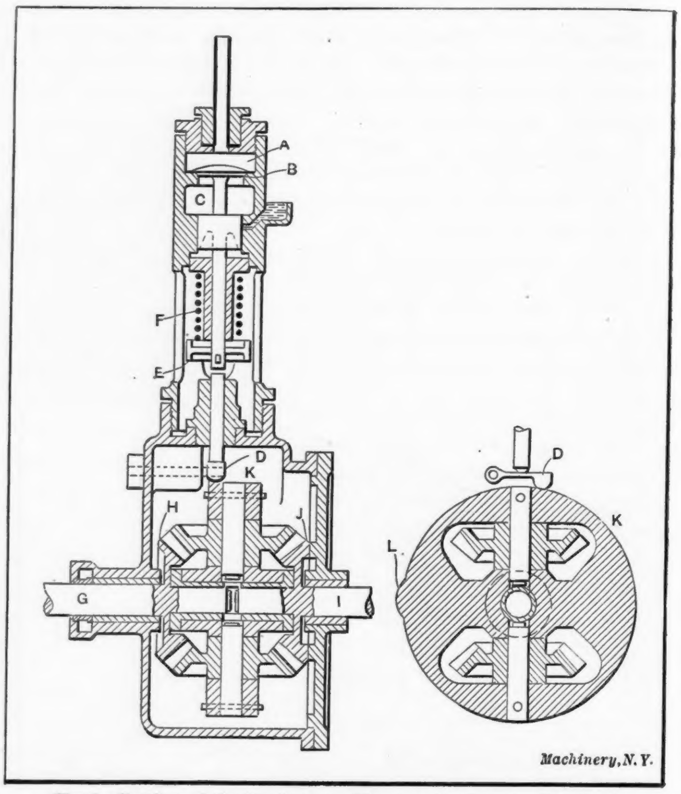


Fig. 1. Section of the Ravigneaux Manograph, showing Principal Working Parts

the pressure indicator is normally intercepted by the balanced valve B, shown in the line engraving Fig. 1. The valve can be raised by the finger D operated by the lobe L on the drum

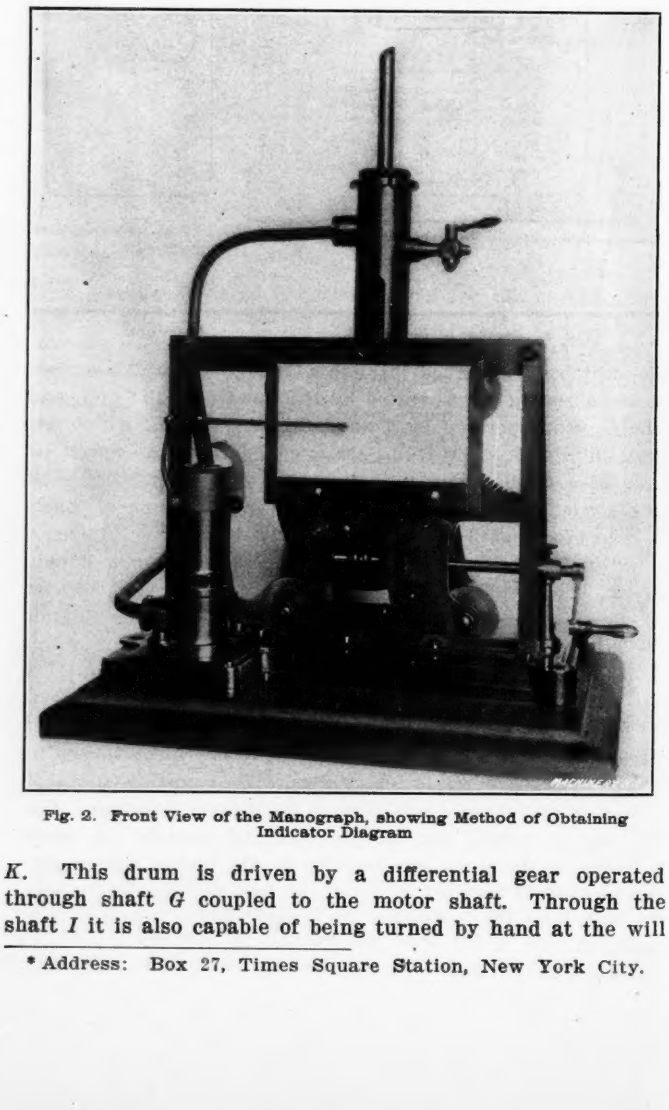


Fig. 2. Front View of the Manograph, showing Method of Obtaining Indicator Diagram

K. This drum is driven by a differential gear operated through shaft G coupled to the motor shaft. Through the shaft I it is also capable of being turned by hand at the will

* Address: Box 27, Times Square Station, New York City.

of the operator. If the shaft I is locked, the differential gear, and in consequence the drum K, will revolve at half the motor speed. The valve B is thus raised once during every cycle, and always at the same point of the cycle, putting into communication the chamber C, communicating with the cylinder, and the chamber A, communicating with the pressure indicator.

If the shaft I is turned a certain distance, the opening of the valve occurs in an advanced or retarded position in relation to the original position of the shaft. By means of a crank and a connecting-rod, the shaft I operates a frame fitted with a diagram card having a horizontal motion in relation to the point of the recording needle. (See Figs. 2 and 3.) The apparatus is set so that when the lobe L is under the push-rod and the valve is raised, the positions of the piston and of the indicator card are correlative.

It is evident from this that for a given position of the indicator card, and also of the piston, the valve is raised and the indicator shows a certain pressure which will be preserved throughout the cycle, that is, until the valve is again raised. If the frame is moved during this time, the point of the indicator will trace a straight line on the card. When the valve is opened again, a sudden change of pressure takes place and the indicator traces a vertical line. The extremity of this line is evidently a point on the indicator diagram. By turning the shaft I very slowly, it is possible to obtain closely located points of pressure, or a practically continuous line. In short, the use of the differential gear allows the opening of the valve at any known point of the stroke of the piston, the indicator card at this moment occupying a position in correlation to that of the piston. This, of course, is all that is required for obtaining a correct indicator diagram.

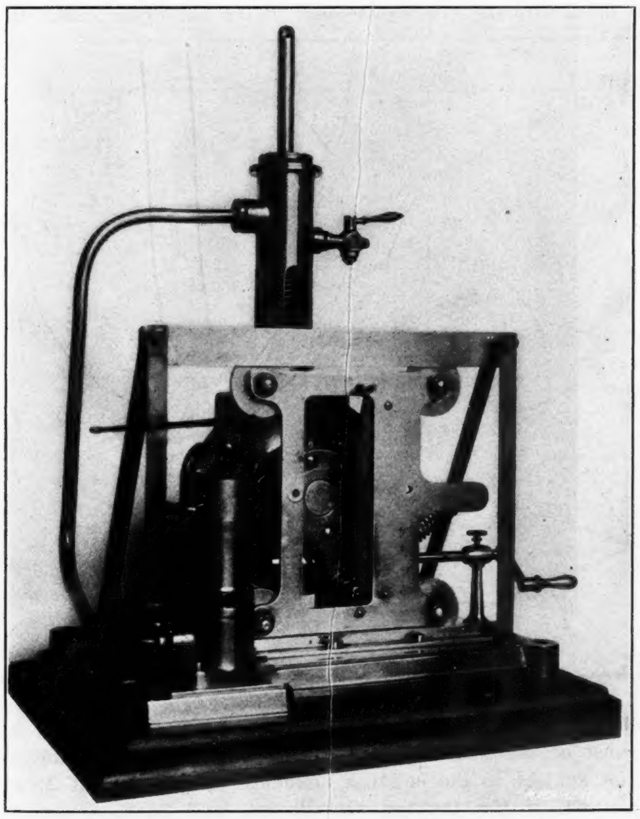


Fig. 3. Front View of Device, showing how Motion is transmitted to Frame on which Indicator Diagram is mounted

[The device described in the foregoing is noteworthy because it makes possible the tracing of a very accurate indicator diagram, and overcomes the great difficulty inherent in most indicators because of the inertia of the moving parts. No matter how light the lever arm holding the indicating point and its connections are made, the rapid motion of the indicator point, when under the sudden action of the pressure from the cylinder gives it a "fling," that is, makes it move further than it should in order to correctly indicate the pressure. In the apparatus just described the individual movements of the indicating point are so small that the inertia of the moving parts may be disregarded, and a diagram which truly represents the average pressure conditions in the cylinder for a large number of strokes, is traced on the indicator card. Another feature of interest is the simple method used for imparting a motion to the frame holding the indicator

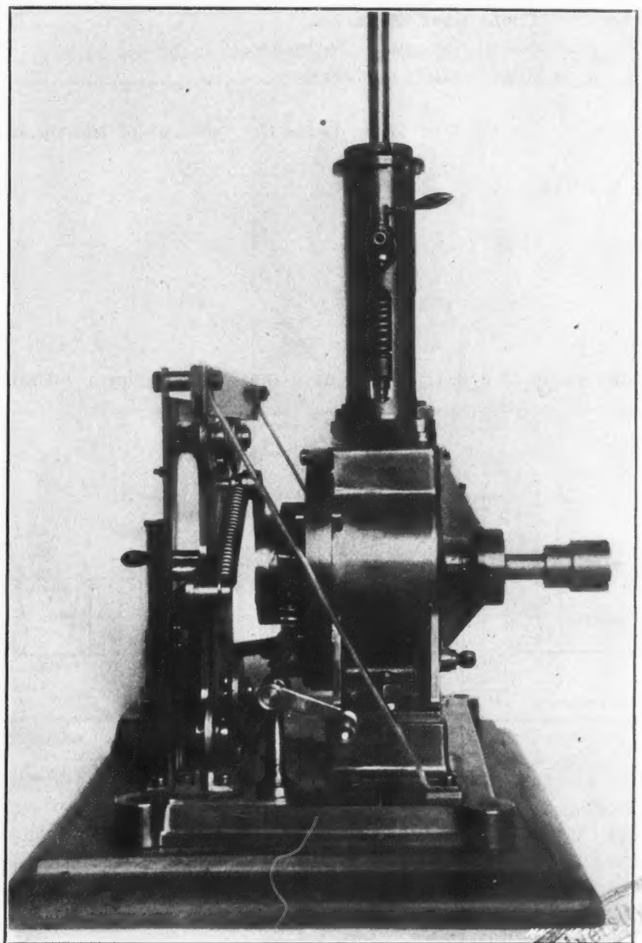


Fig. 4. A Side View of the Manograph

card which corresponds accurately with the motion of the piston. As will be seen in Fig. 3, the frame is operated by a pin on the end of a crank working against a cam surface, which is curved so that the motion imparted by the hand-operated crank is modified to agree with the motion of the piston at every point in the stroke.—EDITOR.]

* * *

Isaac Smith Remsen, president of the I. S. Remsen Mfg. Co., Brooklyn, N. Y., who died October 13, has provided in his will that as "a certain amount of success in general business is due to faithful employes, they are entitled to a share of the assets which have naturally been increased by their cooperation." Therefore, the officers and employes of the company have been left certain sums to be reckoned as follows. After one year's service and up to five years, $100 for all or a portion of the first five years' service; after five years' service the sum of $50 per year up to ten years; after ten years, $100 per year for the entire length of further continued service, no fraction of years to be allowed. The company was formed in 1890 and is thus twenty years old. It builds wagons and manufactures automobile accessories.

* * *

According to the specifications of the United States Navy Department, high speed tool steel furnished to the department must have the following chemical analysis: tungsten, from 18.5 to 19.5 per cent; chromium, from 5.25 to 6 per cent; vanadium, from 0.1 to 0.35 per cent; carbon, from 0.55 to 0.75 per cent; the manganese content must not exceed 0.15 per cent; silicon not more than 0.11 per cent; phosphorus not more than 0.02 per cent; and sulphur not more than 0.02 per cent. There must be no other impurities, and particularly not molybdenum.

DESIGN OF AUTOMOBILE TRANSMISSION GEARS—2*†

By M. TERRY‡

Let I = polar moment of inertia of a square,
y = distance from the center of the square to extreme fiber, in inches,
h = side of the square, in inches,
z = polar section modulus.

$$I = \frac{h^4}{6} = (2 \times \frac{1}{12}\, h^4 = \text{twice the moment of inertia in bending}).$$

$$y = \frac{h}{\sqrt{2}} \quad \text{(Fig. 7)}.$$

$$z = \frac{I}{y} = \frac{h^4}{6} \times \frac{\sqrt{2}}{h} = \frac{\sqrt{2}}{6}\, h^3 = 0.236\, h^3.$$

This value of z is true only as a mathematical proposition.

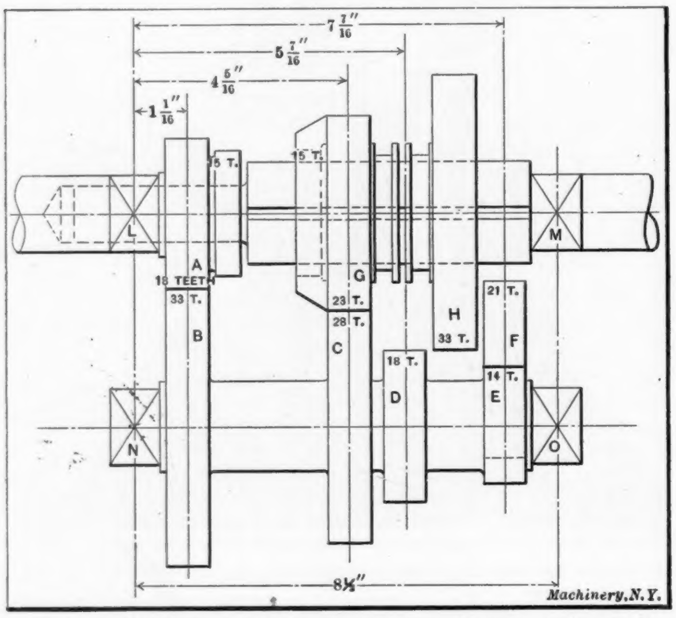


Fig. 2. Typical Automobile Transmission Gear of Sliding-selective Type (Reproduced from October issue)

When shafts of other sections than circular are used in torsion, the stresses existing in them are quite complex, and not subject to simple calculations. (See Report of Chief Engineers, U. S. A., for 1895, p. 3041, part IV.)

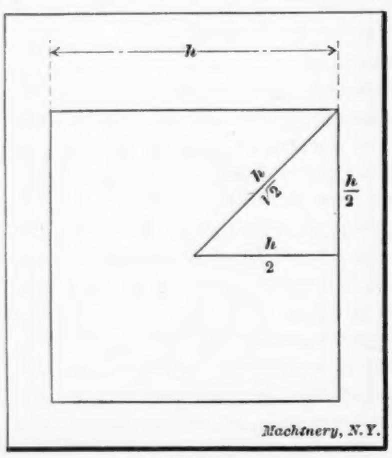


Fig. 7

Hütte & Freytag give the value of

$$z = \frac{2}{9}\, h^3 = 0.222\, h^3$$

American practice puts the value of z at $0.208\, h^3$. Since the extreme edges of square shafts used in automobile transmissions are invariably trimmed off, the value of z probably does not exceed $0.200\, h^3$. To find the size of section of the square shaft, apply the following formula:

$$T_E = zf = 0.200\, h^3.$$

Where $T_E = 11{,}390$ inch-pounds = equivalent torsional moment on slow speed.

and f = safe unit stress = 13,000 to 15,000 pounds per square inch.

$$h = \sqrt[3]{\frac{5\,T_E}{f}} = \sqrt[3]{\frac{5 \times 11{,}390}{14{,}000}} = 1\tfrac{5}{8} \text{ inch.} \quad (A, \text{Fig. 8.})$$

If a splined shaft is to be used, the keys may be assumed to take the shear and the shocks and the remaining circular part of the shaft to resist torsion and bending. Since

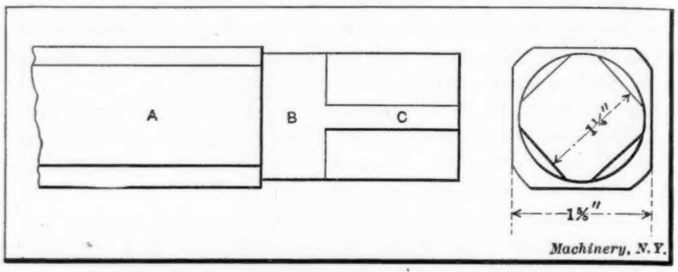


Fig. 8. Typical Automobile Transmission Squared Shaft

the polar section modulus of a round shaft = $0.196\, d^3$ (d = diameter) as compared with $0.200\, h^3$ of a square shaft, the diameter of the main part of the spline shaft will be 1⅝ inch. The keys are usually made by proportion.

In Fig. 8 B represents a journal of a square shaft on which a ball bearing is to be mounted. In addition to their radial load, the bearings employed in transmission are often required to carry a certain amount of thrust load which owes its origin either to the tension of the clutch spring, or angularity of the universal joint or to the driver's effort in shifting gears. The existence of this thrust makes it imperative that A should form a shoulder for B, or, in other words, B must be smaller than A. The end of the shaft, C, is again squared off and fitted into the driving member of the universal joint. In

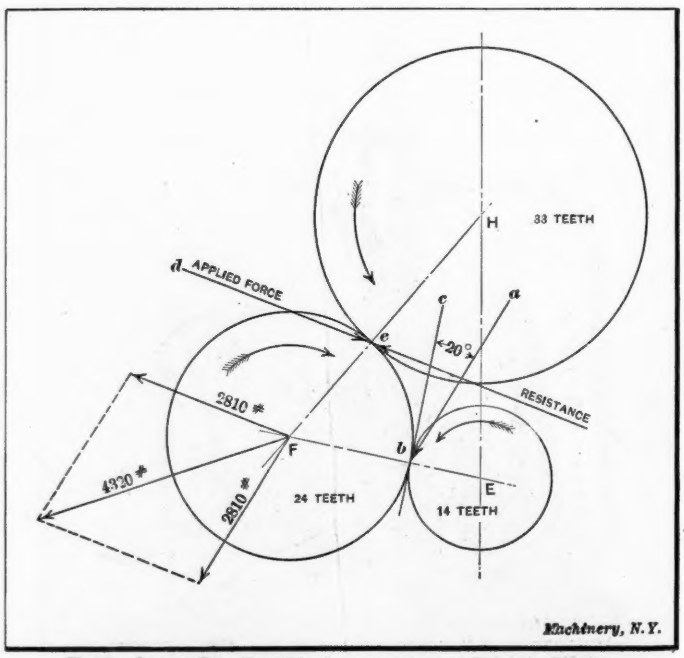


Fig. 9. One of Two Possible Arrangements of Reverse Gearing

order to permit of mounting a ball-bearing on the journal B, C must of necessity be smaller than B. It is clear that C is not subject to the bending moments which exist in A, as explained in the October installment, and consequently C must be designed to transmit merely the twisting moment on the slow speed.

M_T = 5650 inch-pounds. (See Table II.)
f = 13,000 to 15,000 pounds per square inch, safe fiber stress,
h_1 = side of the square C, in inches.
$M_T = 0.200\, h_1^3\, f$.

$$h_1 = \sqrt[3]{\frac{5\,M_T}{f}} = \sqrt[3]{\frac{5 \times 5650}{14{,}000}} = 1\tfrac{1}{4} \text{ inch.}$$

Bearing Pressure.—Postponing for a while all questions relating to the secondary shaft we shall presently turn our attention to the matter of bearing pressures. The first thing

* The first installment of this article appeared in the October number.
† An error appeared in the title of Table II, published in the October installment of this article. Instead of "Twisting and Bending Moments and Tangential Pressures in Transmission," it should read "Twisting and Bending Moment and Bearing Reactions in Transmission."—EDITOR.
‡ Address: 302 Williams St., Flint, Mich.

to settle is the location of the idler gear. Perhaps many readers of this article were never directly connected with the automobile industry and never owned a car. For the benefit of such it may be stated that the vast majority of automobile engines are incapable of reversing (except when they "kick"), *i.e.*, they always turn either in a right-hand or left-hand direction. To provide for the reverse motion of the car, an idler gear is placed between the secondary and primary shafts. The pitch circle of the idler gear F, Fig. 9, must be tangent to the pitch circles of the gears E and H. There are two positions in which the idler gear can be tangent to the

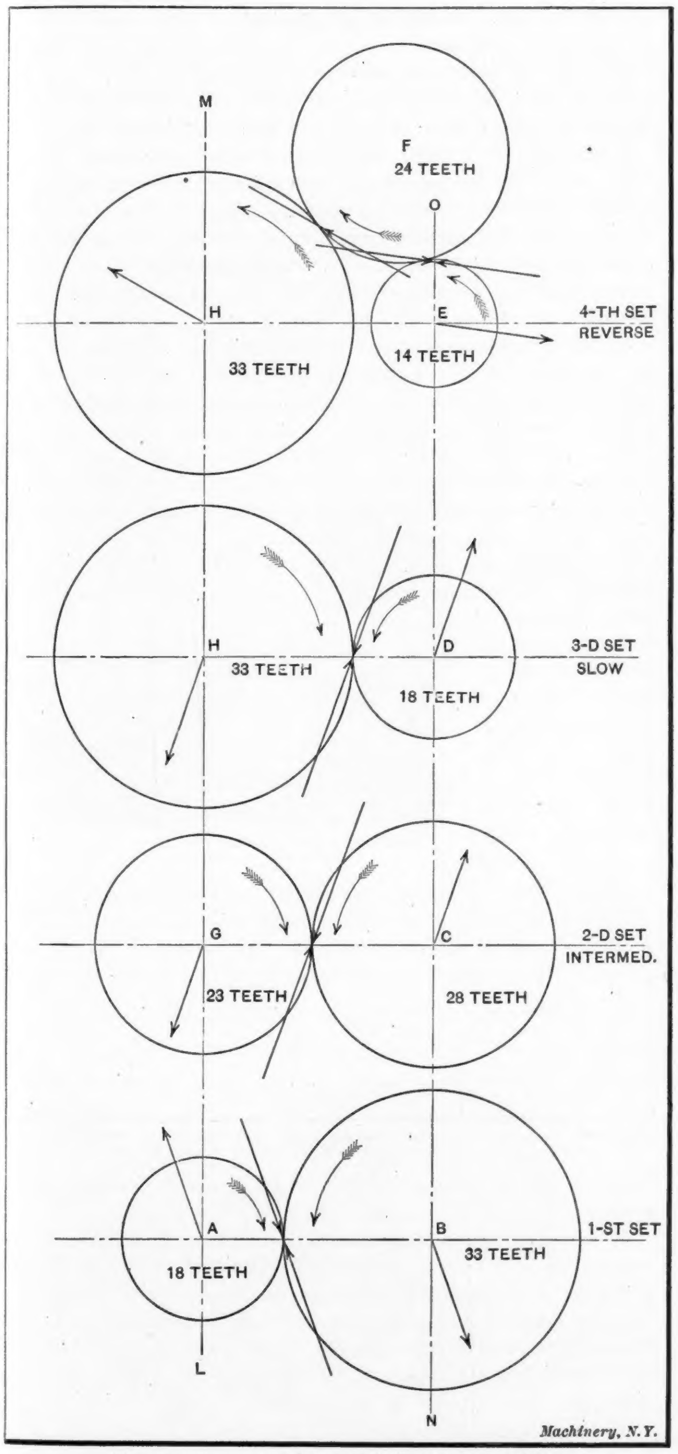


Fig. 10. Diagram of Automobile Transmission Gears

other two gears, and one position is correct while the other is wrong.

Figs. 9 and 11 represent the two possible arrangements of the three gears as they would appear to an observer stationed in front of the car. The engine turns in a right-hand direction. The secondary shaft, of which E is an integral part, turns in a left-hand direction (see Figs. 2 and 10).

Considering E and F first, E is the driver and the pressure takes place along the line a-b, making an angle of 20 degrees with the line c-b, which is perpendicular to the line of centers. The pressure is transmitted unchanged in amount and direction to the bearing of the idler gear F (as explained in the October installment, Fig. 3). This pressure is equal to

$$\frac{\text{Torque on secondary shaft}}{\text{Radius of } E \times \cos 20°} = \frac{3080}{1/2 \times 14/6 \times 0.93969} = 2810$$

pounds.

F being an idler transmits equal pressure to H along the

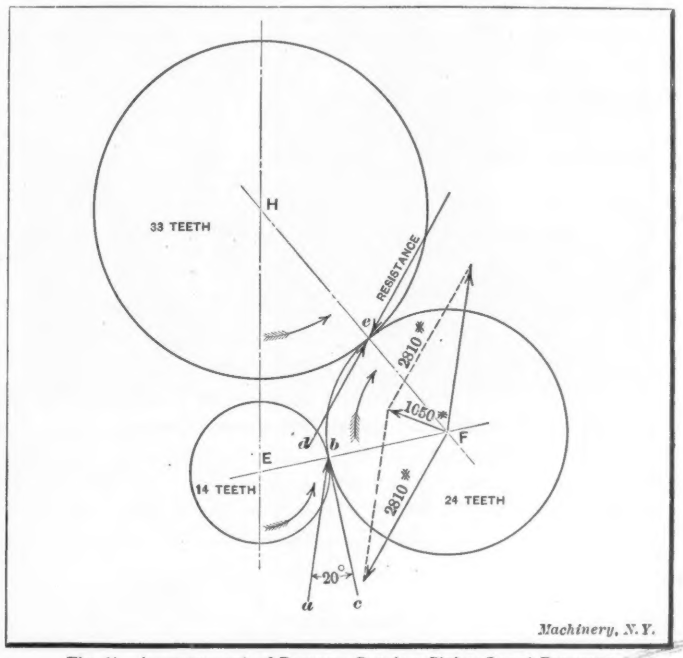


Fig. 11. Arrangement of Reverse Gearing Giving Least Pressure on Bearings

line d-e, which is balanced by an equal and opposite force due to the resistance of H. This resisting force produces a pressure on the idler gear bearing as explained before. Thus, the idler gear bearing is subject to two equal pressures making an angle with each other. In Fig. 9 the angle is such as to

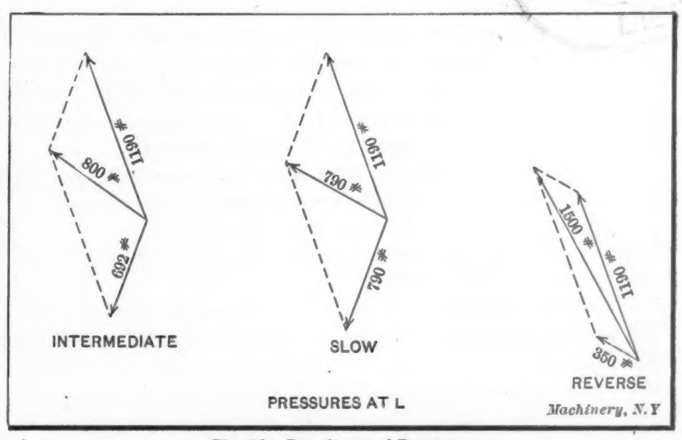


Fig. 12. Resultant of Pressures

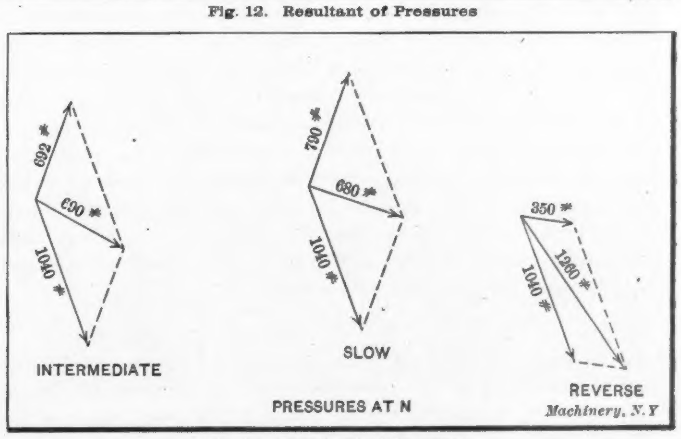


Fig. 13. Resultant of Pressures

make the resultant of the two pressures equal to 4320 pounds. In Fig. 11 the resultant is only 1050 pounds. It is needless to add that Fig. 11 represents the correct position of the idler gear.

Referring to Fig. 2 it will be noted that the distance *L-M* is the same as *N-O*. These were made equal merely to simplify the case, as the pressures at *L* and *M* then (Table II) become identical with those at *N* and *O*. These pressures are produced by either *C* and *G* or *D* and *H* or by *E-F-H*. But, with the exception of direct drive, there are always two sets of gears engaged in transmitting power from the clutch to the universal joint, the first set consisting of gears *A* and *B*, which are in mesh on all speeds.

As before, the torque of the engine shaft as well as of the gear $A = 1680$ inch-pounds.

Pitch radius of $A = 1/2 \times 18/6 = 1\frac{1}{2}$ inch.

$$\text{Tangential pressure} = \frac{1680}{1.5} = 1120 \text{ pounds.}$$

$$\text{Total pressure} = \frac{1120}{\cos 20^\circ} = \frac{1120}{0.93969} = 1190 \text{ pounds.}$$

$$\text{Pressure at } O = \frac{1190 \times 1\ 1/16}{8\frac{1}{2}} = 150 \text{ pounds, about.}$$

Pressure at $N = 1190 - 150 = 1040$ pounds.

This pressure of 1040 pounds at *N* exists in addition to 692 pounds on intermediate speed, 790 pounds on slow, and 350 pounds on reverse. The same is true of *O*. At *L* the ball-bearing supports the gear *A*, which, in turn, affords a support for the square shaft, making the case identical with *N* and *O*. *M*, however, is subject to only one pressure at a time, since the pressure on the gear *A* (1190 pounds) is borne entirely by the ball bearing at *L*.

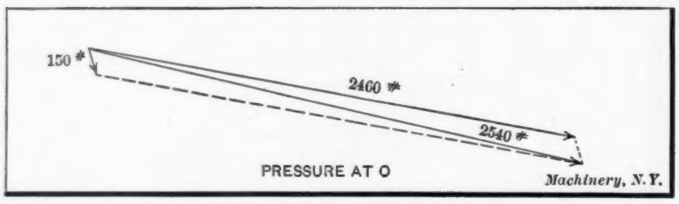


Fig. 14. Resultant of Pressures

Fig. 10 is a diagrammatic representation of transmission gears. Curved arrows indicate direction of rotation of gears. Straight arrows at the points of tangency represent direction of applied and resisting pressures, while those at the gear centers represent the direction of bearing pressure.

In Figs. 12, 13 and 14, these bearing pressures are combined geometrically. To tabulate the results:

Maximum pressure at $L = 1500$ pounds.
Maximum pressure at $M = 2460$ pounds.
Maximum pressure at $N = 1260$ pounds.
Maximum pressure at $O = 2540$ pounds.
Maximum pressure on reverse idler gear bearing = 1050 pounds.

* * *

The House of Representatives of Australia adopted last August by a vote of 35 to 2 a resolution pledging the Government to seek the approval at the next Imperial Conference of the adoption of metric weights and measures throughout the British Empire. The resolution further provides that if this proposition is not adopted, the Government will proceed with the consideration of this reform in Australia, and invite the cooperation of New Zealand. The Russian Government has also prepared a proposition for the introduction of metric weights and measures in Russia. That country is the only one of importance outside of the English-speaking nations, that has not adopted the metric system.

* * *

The taxes on automobiles in Great Britain are determined according to the horsepower, on a rising scale. A car not over 6½ horsepower pays about $10 a year, while a machine of from 35 to 40 horsepower pays a trifle over $50, and one of from 40 to 60 horsepower, slightly over $100 a year. Automobiles with engines rated at over 60 horsepower are taxed at the rate of $202.70 a year. Of the revenue raised by this tax, a part is to be devoted to road improvements.

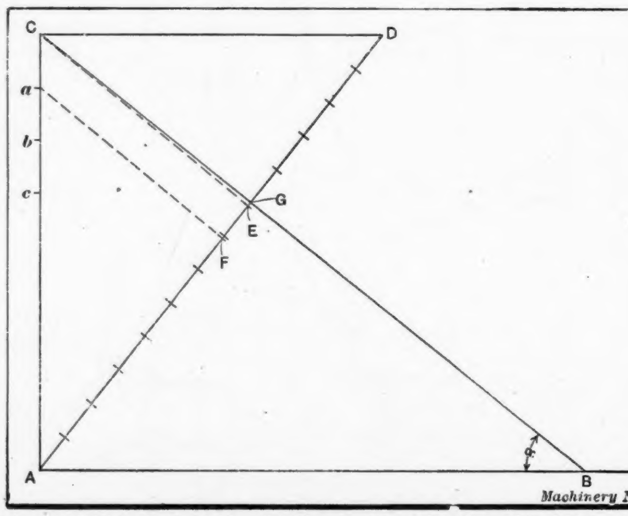
GASHING SPIRAL FLUTED HOBS

By ALPHA

In making worm-wheel hobs of small diameter and of a long lead, it is impossible to get good results in hobbing, if the hob is made with straight flutes, because one side of the teeth will have a drag cut.

There is one objection, however, to spiral flutes with the gash at right angles to the thread, and that is, there is more or less trouble encountered in clearing or backing-off the hob, as the hob-tool will have to advance and drop off in one revolution of the hob, for a different number of flutes than there are in the hob. In fact a hob gashed at right angles to the thread invariably figures out in fractional parts of a flute, as 8.623. If, however, the gashing is changed slightly, it is possible to get a whole number of flutes. The accompanying illustration shows how to plan the gashing graphically.

First, lay off a base line *A-A* of any convenient length. Then erect the perpendicular *A-C* making it equal to the developed length of the pitch circumference of the hob. From *C* draw line *C-D* parallel to the base line *A-A* and of a length equal to the lead of the hob. Now draw diagonal *A-D* which represents the thread. Divide *A-C* into as many equal parts as there are flutes in the hob, as *a*, *b* and *c*. From *C* and *a* draw lines through and at right angles to the diagonal *A-D*, as *C-E* and *a-F*. Then length *E-F* equals the pitch of the flutes on the thread when the gashing is at right angles to the thread. To proceed, divide *A-D* into a certain number of equal parts, the length of these parts to be as near to the length *E-F* as possible. Step off these divisions on *A-D*, and through the division nearest to *E*, as at *G*, draw a line from *C* to the base line intersecting the base line at *B*. This line *C-B* represents the gash, line *A-B* the lead of the gash, and the number of divisions in the line *A-D* equals the number of flutes to one revolution of the hob, for which we must gear the machine.



Graphical Method of Finding Gashing Angle and Number of Flutes for which Backing-off Attachment should be set for Spiral Fluted Hobs

To get the exact length of *A-B*, divide the number of divisions in *A-G* by the number of divisions in *G-D* and multiply the result by the length of the line *C-D* or the lead of the hob. The angle *a* which is the angle for gashing can be found by scaling the diagram. For example, let the hob be 2 inches pitch diameter, lead 5 inches, and number of flutes 8.

We first draw base line *A-A*, and the line *A-C* 6.28 inches long which is the pitch circumference. Now draw *C-D* 5 inches long, and then draw line *A-D*. We now divide *A-C* into eight equal parts and draw lines from *C* and *a* through and at right angles to *A-D*, intersecting *A-D*, at *E* and *F*. Setting the dividers to length *E-F* we step off line *A-D* and find that this length *E-F* will go into *A-D* a little over thirteen times; so we divide this line *A-D* into thirteen equal parts. It is now necessary to gear the machine for thirteen flutes to one revolution of the hob.

The division nearest to *E* is *G*, so by drawing a line from *C* through *G* we intersect the base line at *B*. In the line *G-D*

there are five divisions, and in the line $A\text{-}G$ there are eight divisions. The lead of the hob is five inches, so that the length of the lead for the gash or $A\text{-}B$ is $\frac{8}{5} \times 5 = 8$ inches. By scaling the diagram we find the gashing angle is 38¼ degrees. Therefore, we will gear the machine used in backing-off the hob for 13 flutes to one revolution, and we will gear the milling machine to cut a lead of 8 inches, and at a gashing angle of 38¼ degrees.

* * *

ORNAMENTAL LATHE WORK

By JOHN PEDDIE*

For wasting time which might be profitably devoted to studying Differential Calculus, or otherwise qualifying for a post as moral instructor in a rolling mill, a lathe is as good as anything. Mine is a No. 5 Barnes lathe, having an 11-inch swing to which has been added an overhead works as shown in Fig. 1.

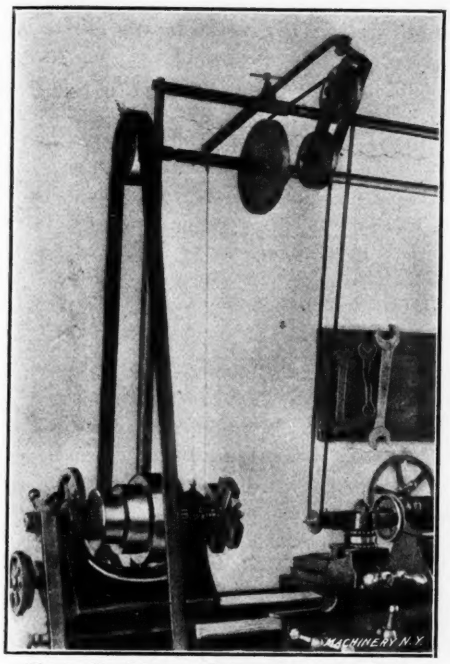


Fig. 1. No. 5 Barnes Lathe Fitted with Special Overhead Works

While a man may be content to use a lathe for nothing else than making foolish trifles called tools, or equally ridiculous masses of mechanism, it is sometimes wise in the interests of domestic felicity to prove to his better half that a lathe is not merely an expensive toy, but a really useful and beneficial invention which enables him to make pretty things for the house, similar to those shown in Fig. 2. These are all made of native New Zealand woods—Kauri and Ironwood, and the simple ornamentations shown on them were produced by means of the drilling spindle shown in position in the toolholder in Fig. 1. The drills were made from steel wire about 3/16 inch diameter, being made straight or bent into crank form as required. The indexing was done as shown in Fig. 3, using suitable change gears as dividing plates. As this method of indexing was somewhat imperfect owing to possibility of play on the key, the writer recently made a division plate which will go on the end of the spindle in the same way as the change gears, and which has a spring index arm attached to the same fastening. To prevent play on the key, the hub of the division plate was made as shown in Fig. 4, the taper cotter with the nut on the threaded end, binding the key firmly.

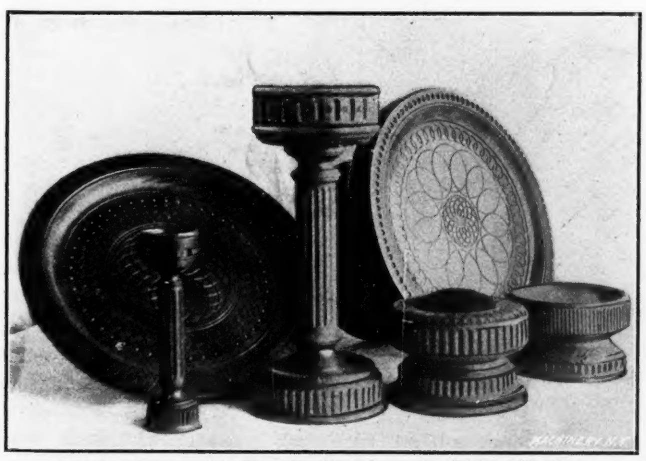


Fig. 2. Ornamental Work Performed on the Lathe with the Attachments shown

*Address: Mataura Paper Mill, Southland, New Zealand.

Fig. 5 shows a division plate in process of being drilled. The method used is thought by some to be well known, although the writer has only seen it described in "Hasluck's Lathe Work"; but in case any reader may be unfamiliar with this class of work, it might be well to mention that the plan consists in drilling a strip of steel, usually a clock spring, with as many holes as you propose to use in your largest circle. The holes are accurately spaced by means of a jig which has a pair of holes in it the required distance apart. This strip is then soldered to form a hoop, suitable precautions being taken to insure the pitch of holes at the joint being correct; it is then fitted on a temporary wooden disk on the lathe spindle, an index being arranged to fit the holes. When

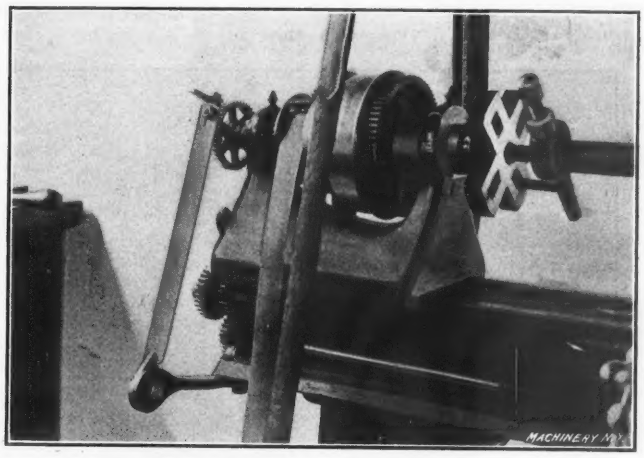


Fig. 3. Indexing Mechanism used in doing Ornamental Work

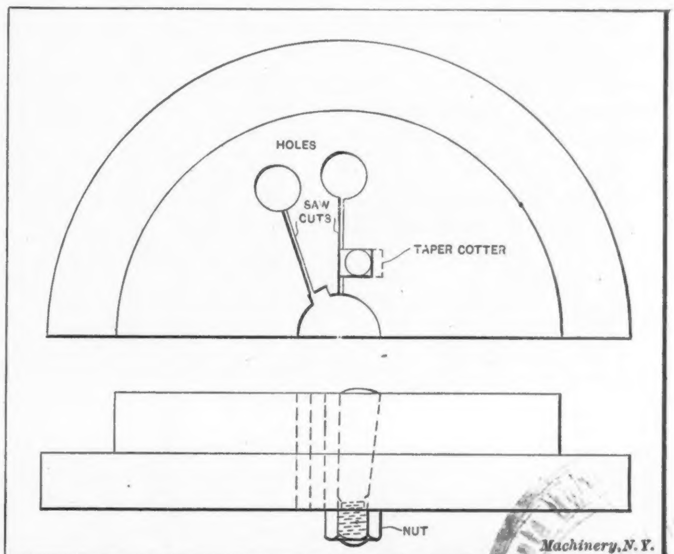


Fig. 4. Improved Indexing Attachment

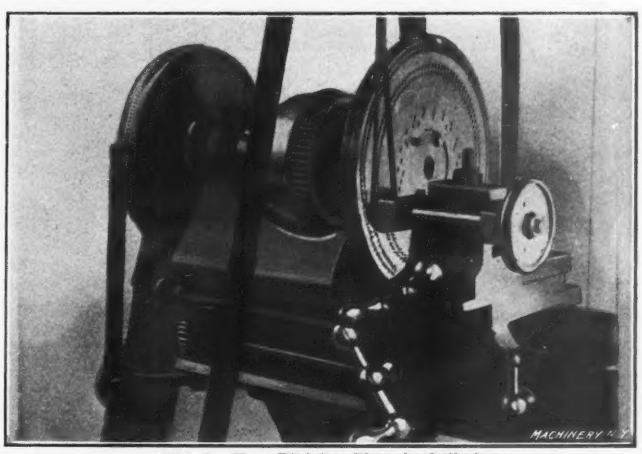


Fig. 5. How Division Plate is drilled

this circle is drilled, the hoop is cut down to the next highest number of holes, again joined and fitted on the disk, and the process repeated until you have as many circles as you propose to drill.

This sort of work is not of much commercial value at the present time, but it provides a sort of romantic pleasure in repeating the work carried on by the early pioneers of lathe work. A better device than that given would be a worm-

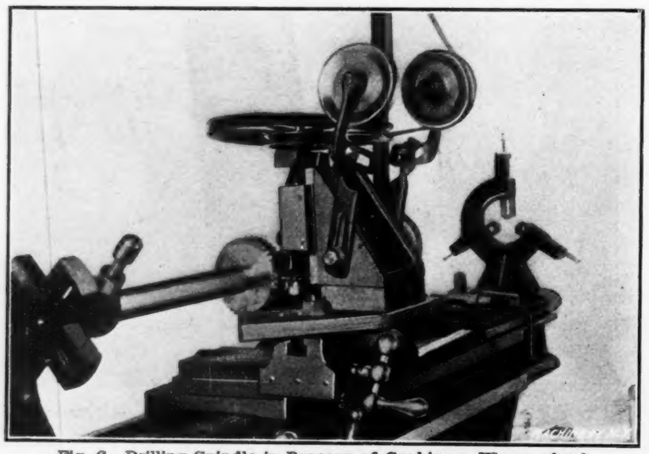


Fig. 6. Drilling Spindle in Process of Gashing a Worm-wheel

wheel to fit on the end of the spindle, with suitable means for indexing.

Fig. 6 shows the same drilling spindle which was used for the ornamental woodwork fitted on a vertical slide, in process of gashing a gunmetal worm-wheel of ¼ inch pitch. A large grooved pulley has been temporarily fixed on the spindle, and with this drive the teeth were gashed quite easily.

* * *

LIMITATIONS IN DESIGN OF THE WÜST HERRINGBONE GEAR

By CHARLES AUGUSTUS

A type of herringbone gear lately brought out by C. Wüst of Subach Zurich, Switzerland, has been attracting much attention. A special machine has been developed for cutting the teeth, using two hobs located diametrically opposite which cut both of the gear faces simultaneously. They may be cut just as accurately, however, on a hobbing machine, on an ordinary universal milling machine, or on a spiral gear cutter if the proper form of cutter is provided and the proper indexing mechanism used.

In cutting these gears it is necessary to stagger the teeth, so that the cutter or hob, on reaching the center of the face when cutting the left-hand spiral can enter the space of the right-hand tooth opposite. There is no other advantage in this. The trouble is that as the angle of the gear is increased, the diameter of the cutter must be reduced or it will cut into the teeth of the opposite hand before it can reach the center of the face and complete the space that it is cutting. As a matter of fact this type of gear is limited to a spiral angle approximating 23 degrees. A five diametral pitch gear containing five teeth, cut at an angle of 45 degrees with the smallest possible cutter could not finish the teeth to within five-eighths of an inch of the necessary distance without cutting into the opposite tooth. In Fig. 1 is shown the cutting of a gear of 23 degrees and in Fig. 2 one of 45 degrees, illustrating this point. It may be argued that this angle is sufficient. Perhaps it is under certain conditions, but not when the face is narrow and high speeds are required, for the steeper angle tends toward quiet operation, although it increases the wear of the teeth for a given load.

A groove turned in the center of the gear face is just as efficient, although not as unique in appearance. This groove, if not made wider than the distance *a* between the far ends of the Wüst teeth as in Fig. 1 does not reduce the face contact beyond that of the Wüst gear, as there is no contact inside the distance *a*. The only drawback is the extra cost of turning out the groove.

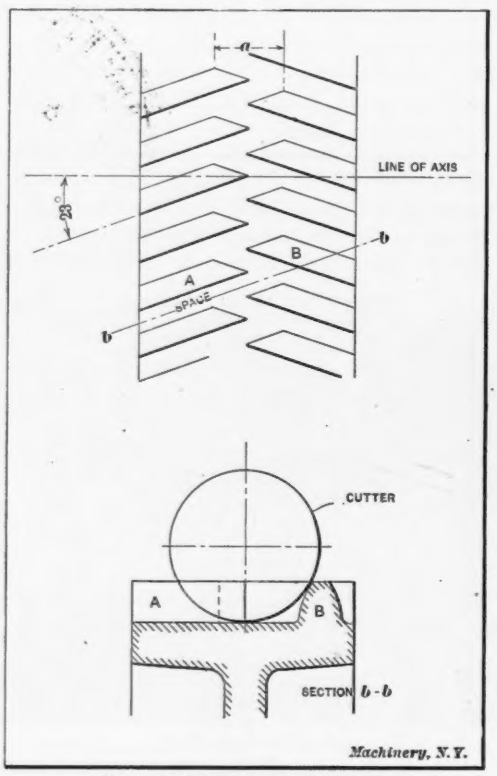


Fig. 1. Wust Herringbone Gear of 23 Degrees

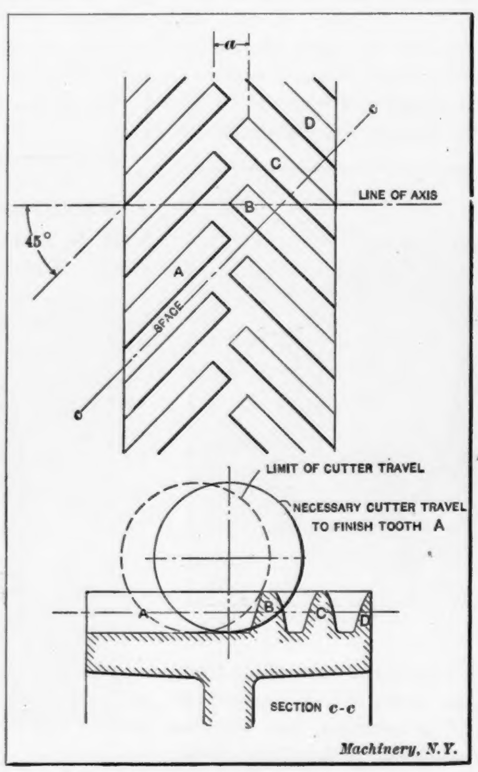


Fig. 2. Showing Action of Cutter at Angle of 45 Degrees

* * *

Some time ago the White Star Line placed two new liners in their Canadian service, the *Laurentic* and the *Megantic*. The *Laurentic* is equipped with a combination of turbine and reciprocating engines, while the *Megantic* is equipped with reciprocating engines exclusively. It was found during the trials of these steamships in regular service that with the same coal consumption the *Laurentic* developed a considerably higher speed, and with the same speed a decrease in coal consumption, amounting to as much as 14 per cent, was effected. This practical proof of the efficiency of a combination of turbine and reciprocating engines for the propulsion of steamships was the cause which induced the White Star Line to equip their new giant steamships, the *Olympic* and the *Titanic*, with a combination of reciprocating and turbine engines.

* * *

A model concrete cottage designed by Mr. Milton Dana Morrill, and which was awarded first prize in the competition of the National Congress for the Prevention of Tuberculosis for a sanitary, inexpensive home for workingmen, will be exhibited at the Cement Show to be held at the Madison Square Garden in New York, December 14 to 20. The house is inexpensive, light and airy, and fills all the requirements of a sanitary and moderate priced house. People who wax too enthusiastic about this house on account of its being so inexpensive, and, therefore, within the reach of workingmen, forget, however, that if houses of this type should become the rule, their cheap price would make the price of land rise in proportion, and as a house cannot be built unless there be a piece of ground on which to put it, the workingman would be just as far removed from the possibility of owning his home as ever.

A LARGE TOOL-ROOM AND ITS SYSTEM

METHODS EMPLOYED IN THE TOOLMAKING DEPARTMENT OF THE TAFT-PEIRCE MFG. CO.

By FRANKLIN D. JONES*

In a small general repair shop back in the country, which —if still in existence—belongs to a class rarely seen at the present time, the "tool-room" was the name given to a fenced-in corner in which a few tools, somewhat better than the general run, were kept, and from which there came an occasional tap of odd size—or perhaps a reamer—to replace one that had been broken by some awkward apprentice. The two toolmakers, who were the only ones ordinarily allowed within this enclosure, were often the objects of considerable envy, as they sat on a stool watching the chips roll from a tool with an infinitesimal feed, the greater part of the day. Considerable care was taken not to overstrain the machines by using anything but a very fine feed, and as the work was of a much higher grade than that done in the shop, it was thought that unlimited time was essential to accuracy; therefore, the time element was never taken into consideration. This tool-room in its inefficiency and its indifference to economical production is not unlike many larger and more pretentious establishments, for, while the importance of the toolmaker has increased with improvements in manufacturing methods, the same management and system effective in the manufacturing departments is not always found in the tool-room.

It is the purpose of this article to point out some of the elements which have a direct bearing upon economical tool production, particularly when conducted on a large scale, by describing a few of the methods employed in the toolmaking department of the Taft Peirce Mfg. Co., of Woonsocket, R. I.

General Description of Tool-room

Before referring to the system employed or the methods of handling work, a general description of the tool-room will be given. This tool-room, two general views of which are shown in Figs. 1 and 9, is, as far as we know, the largest in this country. It has a full working capacity of 250 men and is equipped throughout with modern tools. The length of the tool-room proper is 310 feet and the width 50 feet, which space is exclusive of that occupied by the small tool store-room, the experimental, testing, and punch and die departments. The punch and die department, seen in Fig. 2, forms an extension to one end of the tool-room and contains all the equipment required for accurate die work. The foreman's office is centrally located, and directly opposite it is the ordering and distributing station (shown in Fig. 3), which is a unique and important feature that will be referred to in detail later. The experimental department (Fig. 4), which, as the name implies, is used in the development of special work, adjoins the main tool-room, as does the inspecting department (Fig. 5), where all finished parts are carefully inspected. The tool store-room, in which a complete stock of small tools, such as drills, reamers, milling cutters, gages, files, etc., is kept, is also centrally located. Fig. 6 shows one section of this store room, and also the way the various tools are kept. In the distribution of tools, the well-known check system is used, each man being given a certain number of

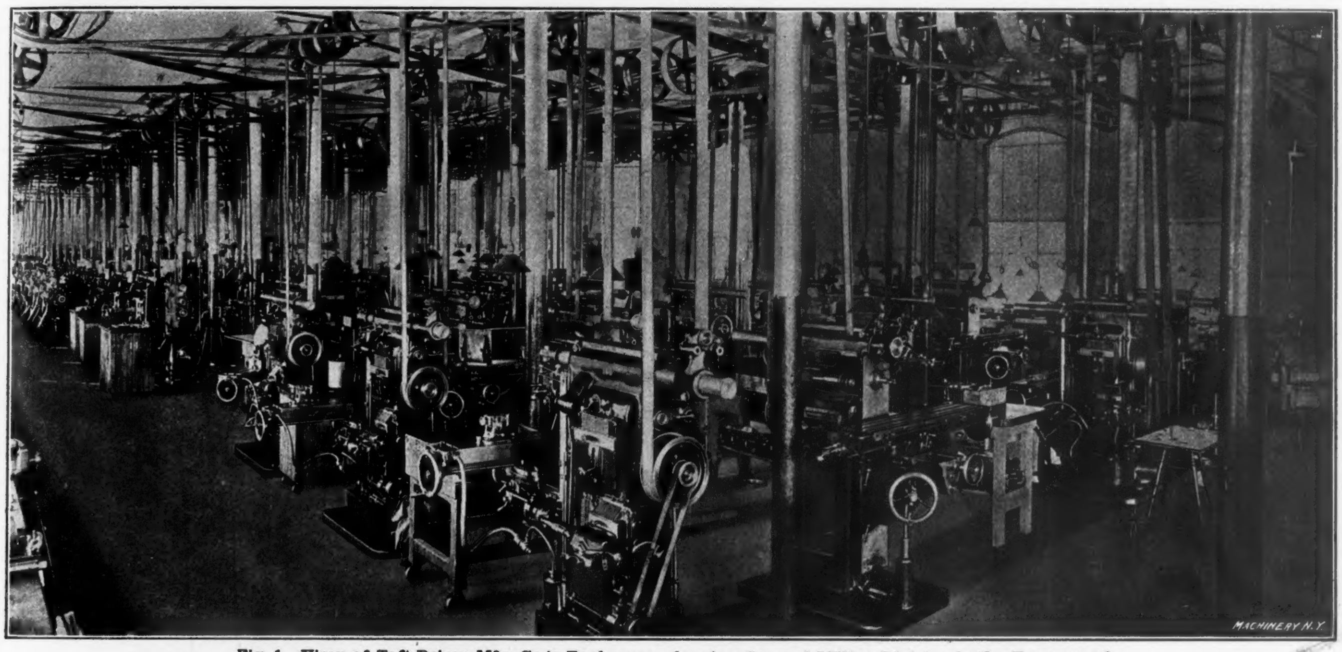


Fig. 1. View of Taft-Peirce Mfg. Co.'s Tool-room, showing General Milling Division in the Foreground

Fig. 2. Punch and Die Division of Tool Department

Fig. 3. Central Ordering and Distributing Station and Foreman's Office

* Associate Editor of MACHINERY.

checks, which are exchanged for tools and show to whom the tools have been given. To avoid confusion and to facilitate the quick delivery of files, a cabinet (Fig. 7), containing all sizes and styles, is located just outside the delivery window. As the illustration shows, each kind of file in the cabinet is numbered, so that the workman can, after determining the size and style wanted, order it by number. This method has been found greatly superior to the old way of using names, which often resulted in confusion and a considerable waste of time.

Careful attention has been given to the arrangement of tools, so that their location will, as far as possible, contribute to the general efficiency. In the foreground of Fig. 9, which is a view from the west end of the room, there is a group of universal milling machines that are used exclusively for jig boring. Just beyond these, all the equipment required for general toolmaking is located, in which is included a group of twenty-four lathes. Adjoining this group of lathes on the far side are the drill presses and miscellaneous tools, such as centering machines, hardening furnaces, straightening

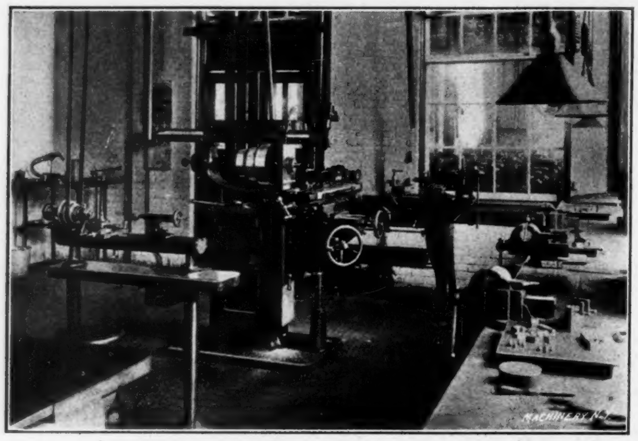


Fig. 4. Special Experimental Department

presses, together with a group of bench lathes, all of which are centrally located. The various tools referred to occupy about one-half the floor space and constitute what might be called the regular toolmaking division. The remaining space is occupied largely by the tools shown in Fig. 1; this view is taken from the east end of the room. The foreground of this illustration shows the general milling division of the tool-room, and just beyond this is the general lathe division. The function of these divisions and their application to the manufacture of fine tools, will be referred to sub-

Fig. 5. Inspection Department

sequently. In order to obtain an independent drive for different sections in the shop the main shaft is divided into ten 32-foot sections, each of which is driven by an electric motor.

Method of Handling Diversified Lines of Work

As the Taft-Peirce Mfg. Co. is engaged in miscellaneous manufacturing, experimental work, etc., the work in the tool-room is greatly diversified, so that it has been necessary to adopt a system that would make it possible to handle, on a commercial basis, the thousand-and-one pieces constantly passing through the tool-room, and at the same time enable any of the parts to be identified with respect to the particular unit or machine of which they are to be a part. This system, as it is connected with the tool-room, and the means of identification, can best be explained by considering a practical illustra-

Fig. 6. Section of Tool Delivery Room

tion. When, for example, a jig has been designed, the drawings for this jig are sent from the drafting-room to the department shown in Fig. 3. From here the necessary stock is ordered and the stock-room, blacksmithshop, or wherever the raw materials are to come from, delivers it to this central department, where it is placed temporarily in a section of one of the partitioned benches shown, which section is numbered to correspond with the job number of the

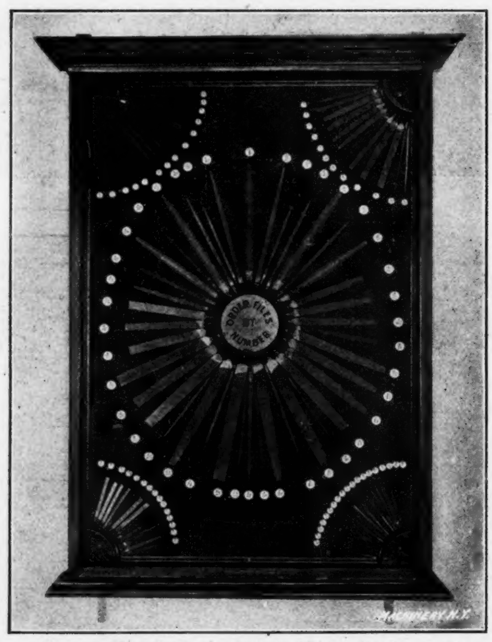
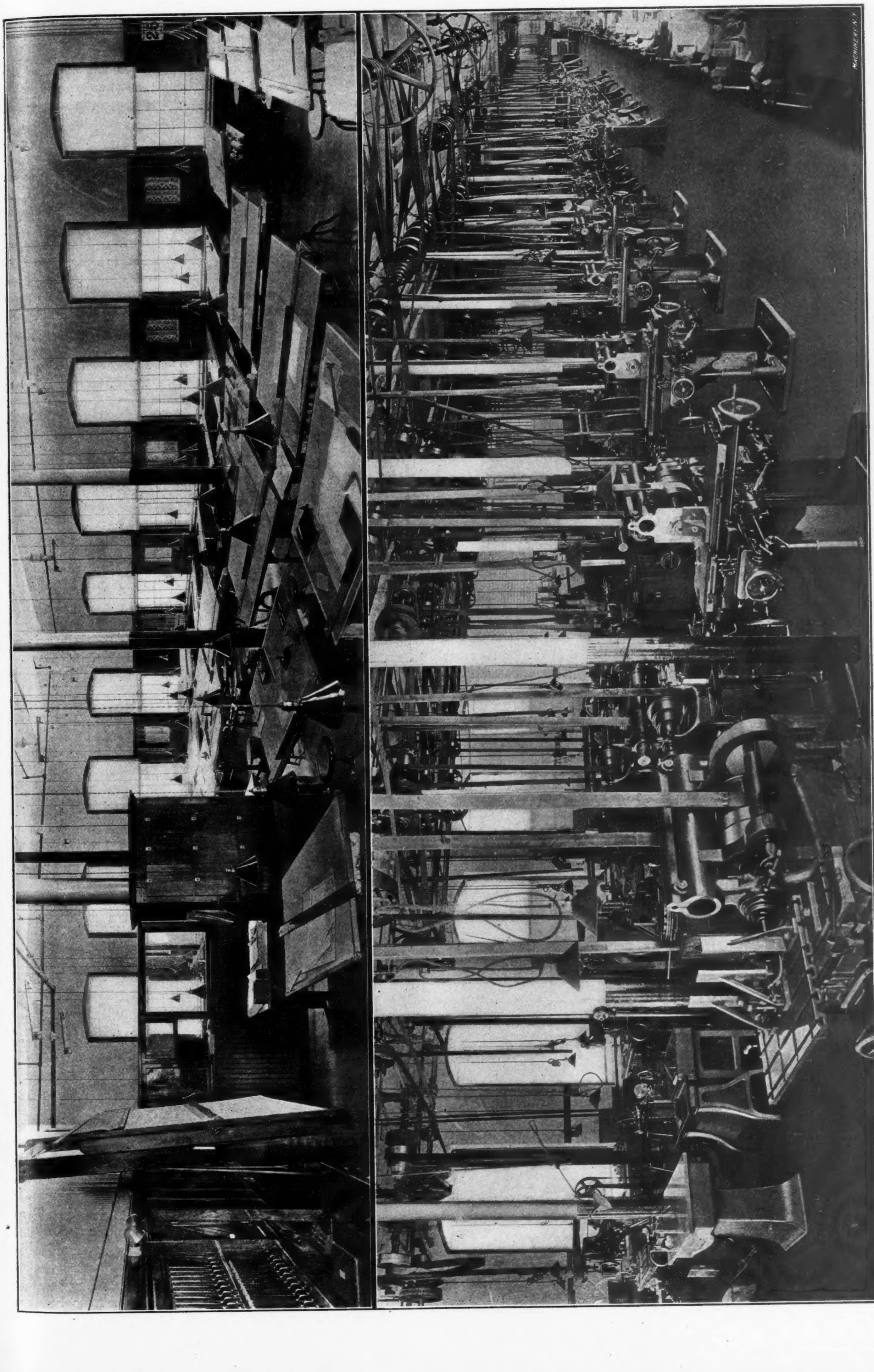


Fig. 7. File Cabinet which facilitates Delivery of any Desired File

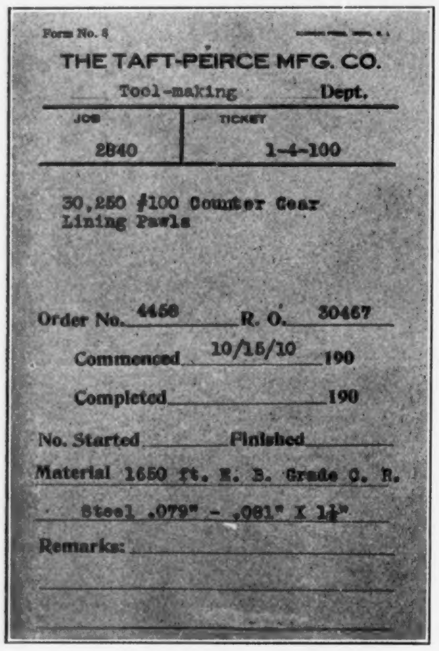
particular jig in question. The rough stock is then distributed, for machining, to the proper department, which again returns it to the central ordering-and-distributing station, whence it passes, if still unfinished, to some other department. In this way the various parts are transferred from one department to another through the distributing station, which is a kind of clearing house for the entire tool-room. By this means all confusion is avoided and the identity and location of any one of the thousands of parts constantly being handled, can be determined at any time, in the clearing house, by suitable slips and cards which give all the required information.

When a drawing is sent to the tool-room, it is accompanied by a card or "ticket" similar to the one shown in Fig. 10. This ticket is made out in duplicate by the engineering de-



Figs. 8 and 9. Panoramic View of Tool-designing Department—View of Tool-room showing Milling Machines Especially Equipped for Jig Boring, in the Foreground

partment where one copy is kept on file. The front of the ticket contains the job number, the name and number of the parts wanted, and other specific information, and on the back the raw material required is marked. From this duplicate ticket a "call card" (Fig. 11) is made out, which is used for ordering the raw material. This card shows just what is wanted, when the material will probably be needed and also to which department it should be sent. In addition to the call or order card, there is a "delivery card" (Fig. 12) which, if material is wanted at once, is sent out with the call card. This delivery card, which is placed on file, shows when the material was delivered and also serves an important purpose in connection with the cost department. As each individual piece of raw material is received at the distributing station, it is checked off on the back of the duplicate ticket, so that the foreman can see at a glance when all the material required for the particular job represented by that ticket has arrived. The material is then ready for the machines, but until actually sent out, it is kept in a numbered space on one of the benches, set apart for that particular work, so that all pieces, whether in the rough or partly



Form No. 6

THE TAFT-PEIRCE MFG. CO.

Tool-making Dept.

JOB	TICKET
2840	1-4-100

30,250 #100 Counter Gear Lining Pawls

Order No. 4458 R. O. 30467

Commenced 10/15/10 190

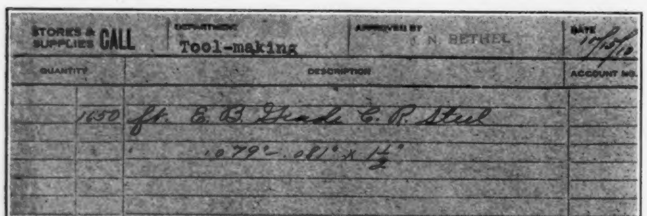
Completed 190

No. Started Finished

Material 1650 ft. E. B. Grade C. R. Steel .079" - .081" X 1¼"

Remarks:

Fig. 10. Duplicate Ticket which aids Foreman in Handling Diversified Lines of Work



STORES & SUPPLIES CALL — Department: Tool-making — Approved by: C. N. BETHEL — Date: 11/15/10

QUANTITY	DESCRIPTION	ACCOUNT NO.
1650	ft. E. B. Grade C. R. Steel	
	.079" .081" x 1¼"	

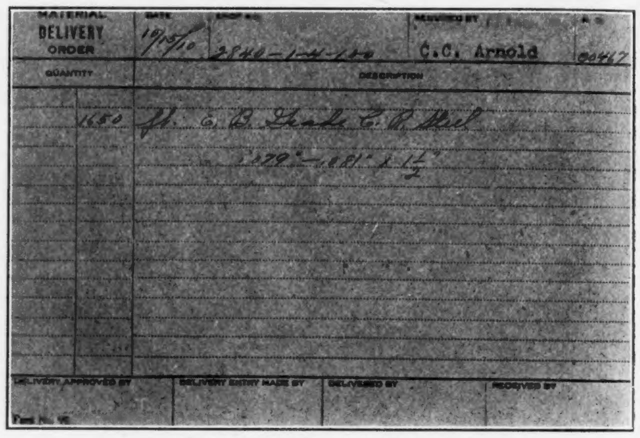
Required by: C. C. Arnold — For R. O.: 30467 — Shop No.: 2840-1-4-100 — To be used for: Counter Gear Lining Pawl

Fig. 11. Card used for Ordering Raw Material

finished, which are not actually being worked upon, are in plain sight of the foreman, and the number of the section in which they are kept enables immediate identification if this should be necessary. Another form or card which serves a useful purpose is shown in Fig. 13. This card, known as the "operation transfer," is used when parts are transferred from one department to another. When, for example, a piece is sent from the tool-room to the hardening room, the transfer card, which accompanies it, shows that the hardening room is its destination and also where it should be taken next. This card, as well as the others referred to, also shows by suitable numbers just what job the part is for and also its relation to that particular job.

Specialization in Tool-room Practice

In most tool-rooms, the toolmaker, when given a certain piece of work, finishes it complete, regardless of the nature of the work or the number of operations which may be required for its completion. If turning, milling, drilling and grinding are necessary, all these operations are performed successively by one man. This method is undoubtedly preferable for certain classes of work, but it is inefficient in the production of other parts, particularly when considerable roughing is required. For this reason, the tool-room of the Taft-Peirce Mfg. Co. is equipped with the lathe and milling machine divisions previously referred to. The general lathe division is shown in Fig. 14, and the milling division, in the foreground of Fig. 1. In these departments that branch of tool-making which, for the most part, is on a par with high grade manufacturing, is performed. When considerable turning or milling is necessary on a certain part, it is sent to the general lathe or milling machine division, as the case may be, where the work is done by a specialist better fitted for this kind of work than a toolmaker, whose training and experience has been mostly on delicate and extremely accurate work. The machines in these departments are of modern high-power types, adapted to the line of work for which they are used. By this method the cost of producing a large percentage of the fine tool work done in this shop is greatly diminished, as the light and delicate



MATERIAL DELIVERY ORDER — Date: 11/15/10 — Shop No.: 2840-1-4-100 — Required by: C. C. Arnold — R. O.: 30467

QUANTITY	DESCRIPTION
1650	ft. E. B. Grade C. R. Steel
	.079" .081" x 1¼"

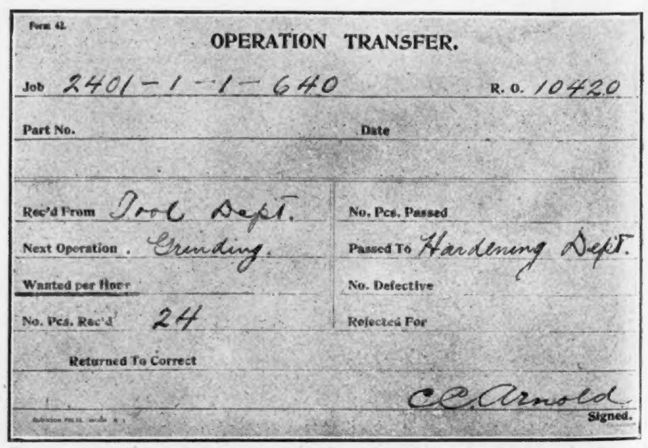
Delivery approved by — Delivery entry made by — Delivered by — Received by

Fig. 12. Card for Ordering Delivery of Material

and the heavier and, in most cases, less accurate machining are each done by a specialist. Specialization has also been applied, as far as practicable, to the machine work itself and to assembling. In the lathe division, chucking, taper turning, etc., are performed separately, and in assembling, parts that are similar are assembled, as far as possible, together.

Jig Boring in Milling Machines

Owing to the wide variety of special tools, light machinery and mechanical specialties, manufactured by this company,



Form 41.

OPERATION TRANSFER.

Job 2401-1-1-640 R. O. 10420

Part No. Date

Rec'd From Tool Dept. — No. Pcs. Passed

Next Operation Grinding. — Passed To Hardening Dept.

Wanted per Hour — No. Defective

No. Pcs. Rec'd 24 — Rejected For

Returned To Correct

C. C. Arnold Signed.

Fig. 13. Slip used when Transferring Work from One Department to Another

much of the work in the tool-room consists in the making of high-grade jigs and fixtures. In the boring of these jigs the specialist is again utilized effectively. Milling machines are employed for this work, and, while the use of such machines for jig boring is not new, a general description of the method of procedure and the equipment employed will doubtless be of some interest. The seven universal machines shown in the foreground of Fig. 9 and the vertical miller to the left, are used exclusively for jig boring. All these machines are

equipped with special scales and verniers which enable adjustments to be made in any direction, with accuracy. For a certain class of work, the setting obtained by the scales is relied upon, but when extreme accuracy is required, the center-to-center distances are checked by taking direct measurements with a vernier or micrometer across ground plugs which accurately fit the holes. An example of work requiring such measurements is shown set up in the machine in Fig. 15, it being necessary to bore the outer holes in correct relation with the center hole within 0.0005 inch. Another method of locating jigs, which is employed in certain cases, is shown in Figs. 16 and 17. At one end of the jig to be bored, an accurate angle-plate is set up as shown. This plate is set parallel with the machine spindle by the use of an indicator as illustrated in Fig. 18, which shows a larger plate being aligned. When the work is to be adjusted horizontally, a

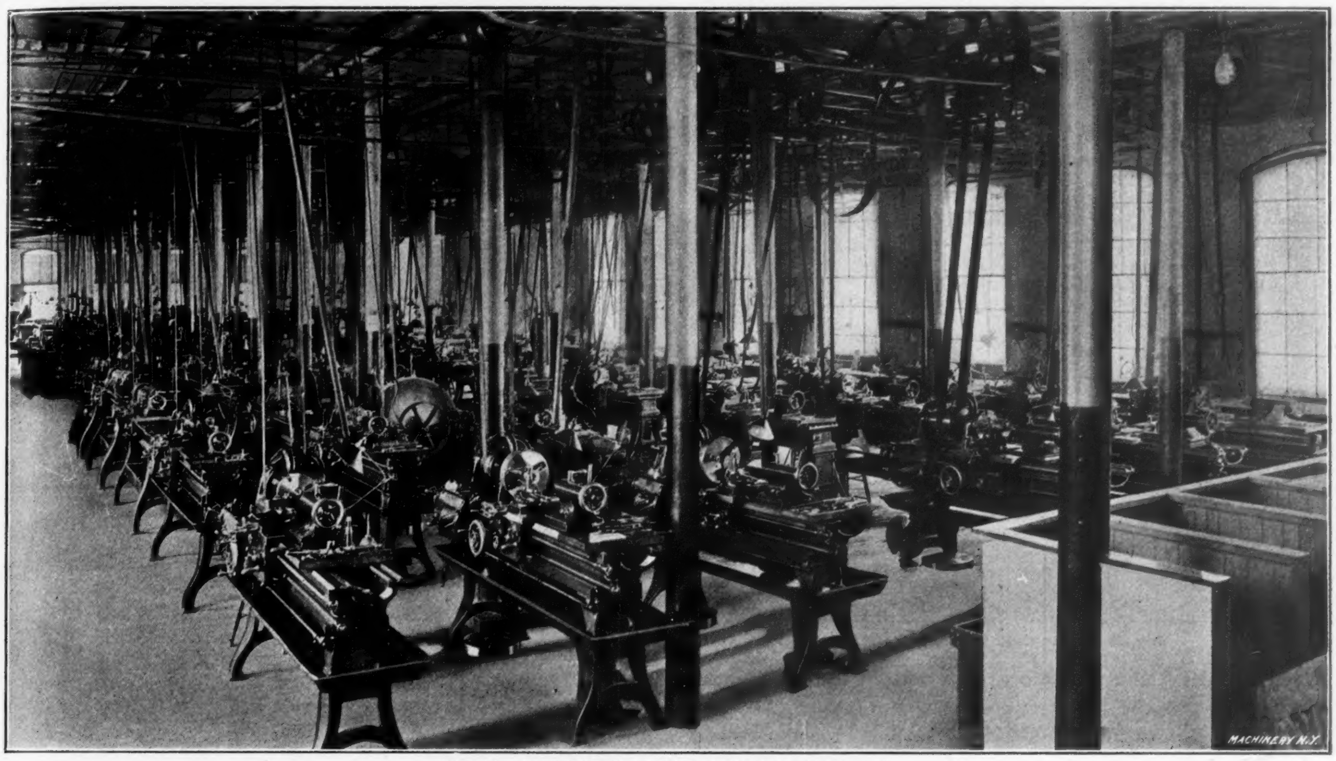


Fig. 14. General Lathe Division of Tool Department

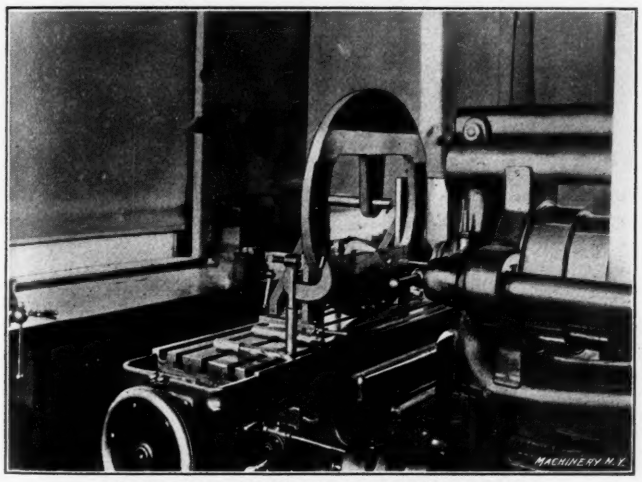


Fig. 15. Example of Jig Boring in Milling Machine

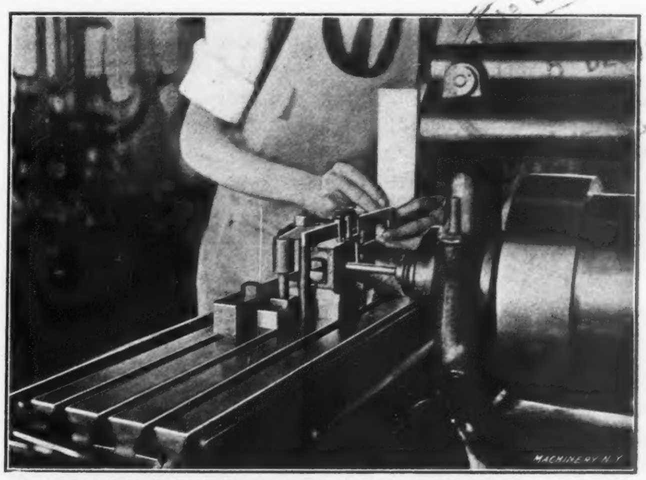


Fig. 16. One Method of Setting the Work—Making a Horizontal Adjustment

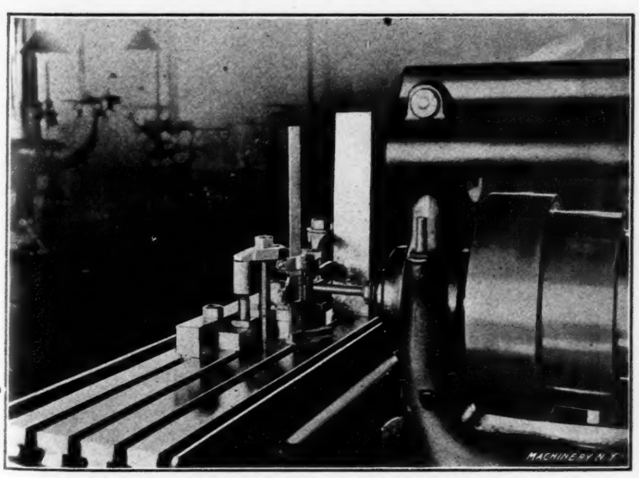


Fig. 17. Method of Making a Vertical Adjustment

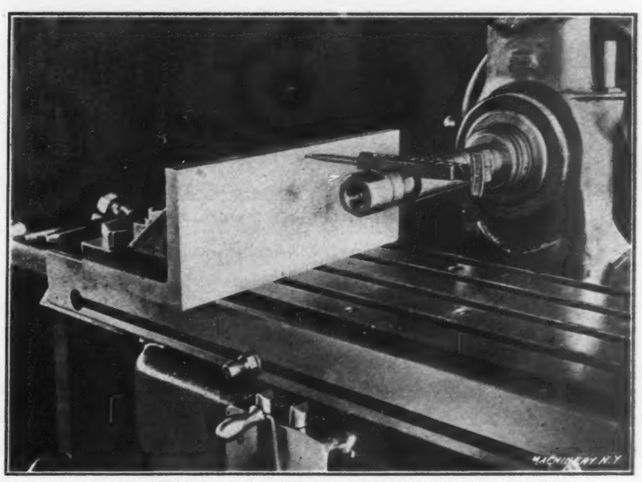


Fig. 18. Setting an Angle-plate Parallel with the Spindle

vernier height gage is used as in Fig. 16, the base of the gage resting on the angle-plate and the measurement being taken to an accurately ground and lapped plug in the spindle. For vertical adjustments, the measurements are taken between this ground plug and the machine platen as in Fig. 17.

Samples of the tools with which these machines are equipped are shown in Fig. 19. At *A* are the drills used; at *B*, the mills, or, more properly, the reamers for finishing; at *C*, a spindle collet for holding the various tools; at *D*, a test plug; at *E*, an adjustable boring tool; and at *F*, reducing collets

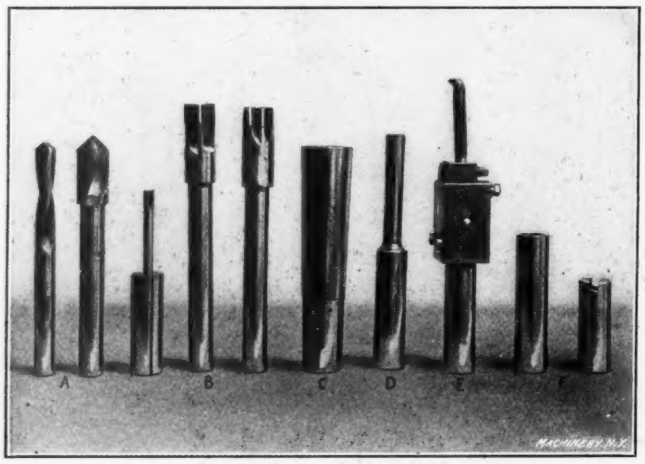


Fig. 19. Tools used for Jig Boring

for small drills. The reamers are in both roughing and finishing sizes, and the latter are of the split adjustable type, so that the size can be retained. There is a complete set of these reamers in various sizes, so that most of the bushing holes are finished to a standard diameter. One advantage incident to this method of finishing the holes, aside from the limited time required, is that holes of a standard size, permit the repeated use of test plugs, so that it is not necessary to be continually making new ones. When a hole of odd size is to be bored, the adjustable tool shown at *E* is used.

While most of the jig boring can be handled to the best advantage in a horizontal machine, for certain classes of

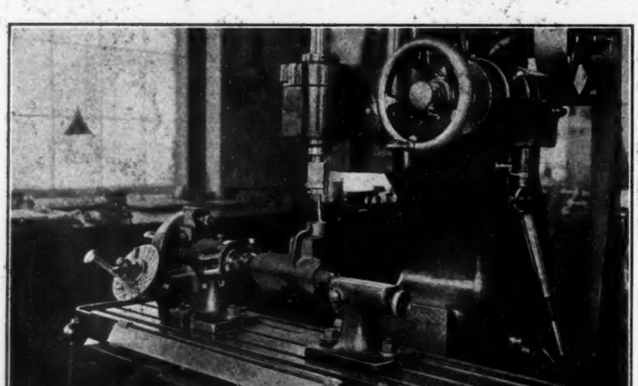
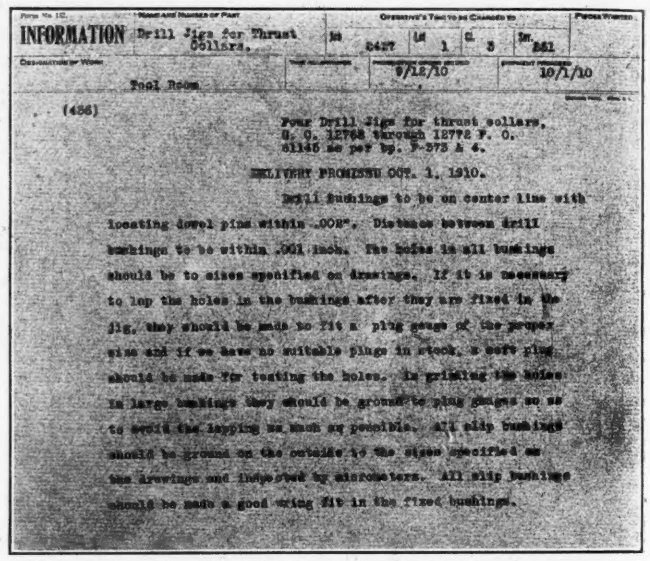


Fig. 20. Example of Jig Boring on a Vertical Milling Machine

work the vertical type has its advantages. An example of work adapted to the vertical miller is shown set up in the machine in Fig. 20. As the particular hole being bored had to be at an angle of 25 degrees with a finished surface on the base, the jig was mounted between the centers of a dividing head which was used for obtaining the angular setting after the surface referred to had been milled. This illustration also shows the scale and vernier for measuring longitudinal adjustments, the former being attached to the table and the latter to the saddle. The vernier and part of the scale for measuring the cross movement may also be seen just to the left of the knee. These scales greatly facilitate the operation of jig boring and they can be used to advantage on a variety of work.

Drafting-room

The cooperation between the drafting-room (Fig. 8) and the toolmaking department is such that this article would not be complete without reference to some of the features which have a direct bearing on the work of the tool-room. Noteworthy among these features is the plan to eliminate "double thinking," and at the same time give the workman a clear understanding of just what is needed on a given job as to accuracy, etc. This is accomplished by the use of information blanks such as the one shown in Fig. 21. These blanks are attached to the blueprints—when they can be used to advantage—and contain practical information for the guidance of the workman. The character of this information is such as to insure the production of work which, as regards accuracy and general finish, will meet the requirements. By this method, a part is made just as good as it needs to be, but unnecessary expense for accuracy and polish which would be useless is avoided. The general utility of these infor-



INFORMATION Drill Jigs for Thrust Collars.

8427 1 3 261

Tool Room 9/12/10 10/1/10

(486)

Four Drill Jigs for thrust collars, G. O. 12768 through 12772 F. O. 61145 as per bp. F-373 & 4.

DELIVERY PROMISED OCT. 1, 1910.

Drill bushings to be on center line with locating dowel pins within .002". Distance between drill bushings to be within .001 inch. The holes in all bushings should be to sizes specified on drawings. If it is necessary to lap the holes in the bushings after they are fixed in the jig, they should be made to fit a plug gage of the proper size and if we have no suitable plugs in stock, a soft plug should be made for testing the holes. In grinding the holes in large bushings they should be ground to plug gages so as to avoid the lapping as much as possible. All slip bushings should be ground on the outside to the sizes specified on the drawings and inspected by micrometers. All slip bushings should be made a good wring fit in the fixed bushings.

Fig. 21. Information Slip which accompanies Drawings when Necessary

mation slips will be more clearly understood by quoting the instructions given on the particular one illustrated. After the identification numbers and other miscellaneous data, the following instructions appear:

"Drill bushings to be on center line with locating dowel pins within 0.002 inch. The distance between drill bushings to be within 0.001 inch. The holes in all bushings should be to the exact sizes specified on drawings. If it is necessary to lap the holes in the bushings after they are fixed in the jig, they should be made to fit a plug gage of the proper size and if we have no suitable plugs in stock, a soft plug should be made for testing the hole. In grinding the holes in large bushings they should be ground to plug gages, so as to avoid lapping as much as possible. All slip bushings should be

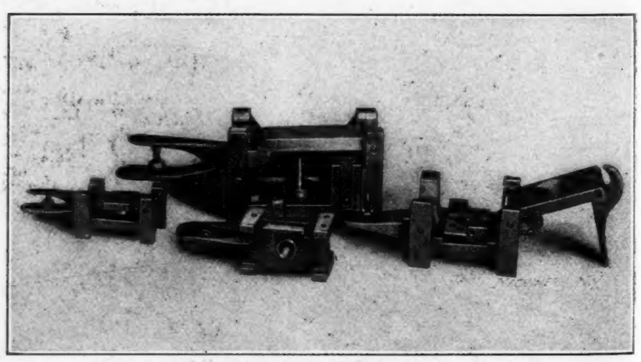


Fig. 22. Examples of Standardized Jig Construction

ground on the outside to the size specified on drawing and be inspected by micrometers. All slip bushings should be made a good wringing fit in the fixed bushings."

The "operation sheet" is another important aid which is given the tool-room from the engineering department. This sheet, which is issued in certain cases, gives all the opera-

tions required for finishing given parts in their respective order, and also a list of the tools required for each operation.

Owing to the diversified nature of the work, which ranges from the development of some small tool or machine to the designing of a complete tool equipment for the inter-

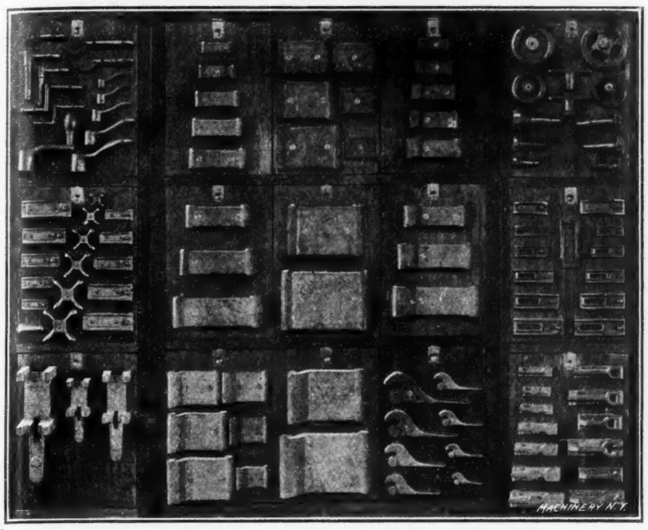


Fig. 23. Cabinet of Standard Parts for Reference of Draftsmen

changeable manufacture of a complicated mechanism, the standardization of parts presents, of course, unusual difficulties. Notwithstanding the nature of the work, however, much has been accomplished along this line. Fig. 22 shows a standard type of jig, in different sizes, which with certain

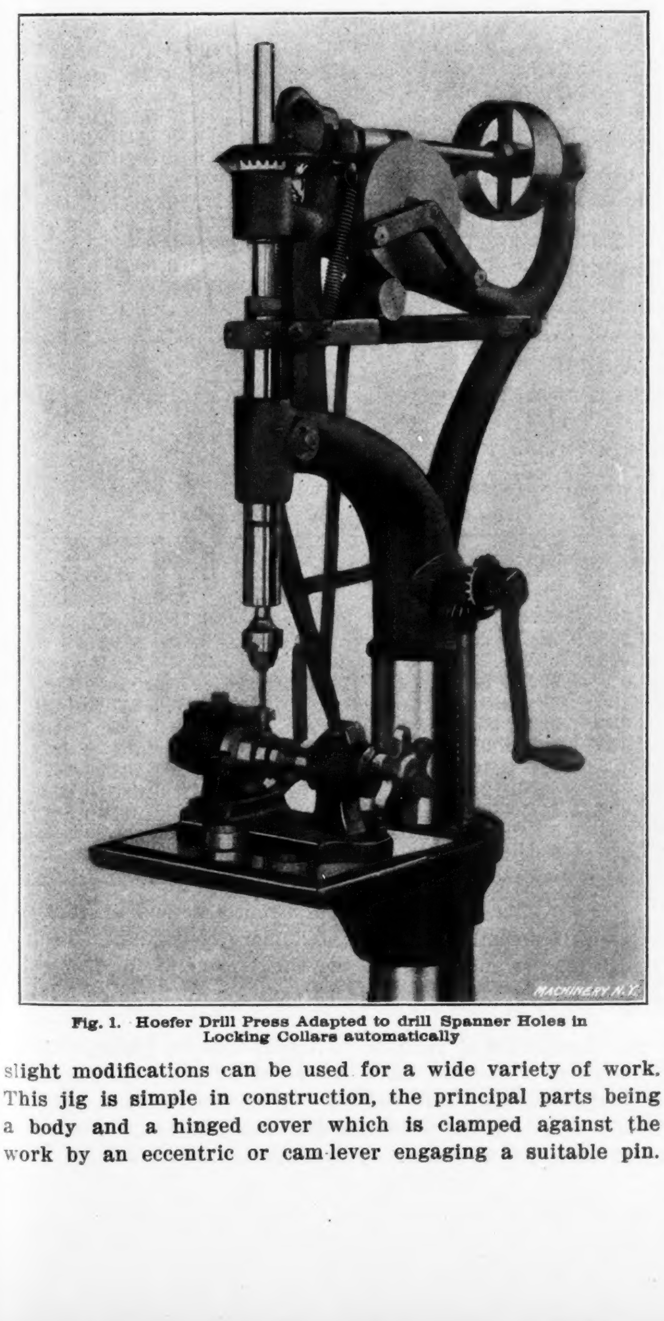


Fig. 1. Hoefer Drill Press Adapted to drill Spanner Holes in Locking Collars automatically

slight modifications can be used for a wide variety of work. This jig is simple in construction, the principal parts being a body and a hinged cover which is clamped against the work by an eccentric or cam lever engaging a suitable pin. For the convenience of the designer, samples of standard jig and fixture parts are kept in the drafting-room attached to a cabinet as illustrated in Fig. 23. Standard die-beds and other parts have also been adopted as far as possible. For the most part, however, it is necessary to devise special tools and means, owing to the experimental nature of a large part of the work.

* * *

DRILLING SPANNER HOLES IN LOCKING COLLARS

By ETHAN VIALL*

The accompanying illustrations, Figs. 1 and 2, show the ingenious way in which a Hoefer drill press, in use at the plant of the Mitchell Motor Car Co., Racine, Wis., has been fitted to automatically drill the spanner holes in locking collars, two of which are shown on the table just in front of the jig. A worm on the driving spindle meshes with a worm gear and turns the cams which work the lever operating the drilling spindle. The cam plate on the other side of the one shown in Fig. 1, carries a pin which operates the indexing mechanism.

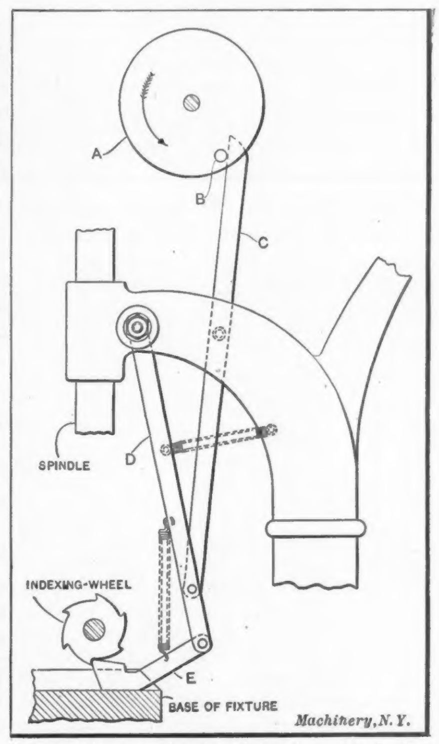


Fig. 2. Diagram showing Operation of Indexing Mechanism

The indexing mechanism is more clearly shown in Fig. 2, where *A* is the cam plate which carries the pin *B*. As the plate *A* rotates in the direction of the arrow, the pin *B* trips the lever *C*, which, in turn, operates the lever *D*, causing the dog *E* to slide back and forth, thus rotating the indexing wheel.

* * *

RAISING THE "MAINE"

An appropriation of $300,000 was made during the last session of Congress for raising the *Maine*, the United States battleship sunk in Havana Harbor, February 15, 1898. The work will be done under the direction of the army engineers and the plan for raising the wreck is to enclose it with a steel coffer dam, pump out the water, repair the hull and float the vessel by admitting the water when all repairs are made. The plan is substantially the same as that described in the January, 1905, number of MACHINERY, when a private concern proposed to raise the vessel and reimburse itself by exhibiting it as a curiosity and by selling souvenirs made from the metal of the hull. The coffer-dam plan is considered feasible. The wreck lies in 25 feet of water and in a stratum of soft mud from 5 to 8 feet deep. Beneath the mud is a stratum of hard clay, into which the interlocking steel piles will be driven.

* * *

Some experiments with aeroplane engines have recently been carried out at the National Physical Laboratory in England. It appears that the economy of the aeroplane engine as compared with that of a good automobile engine is rather low. The aeroplane engines are much lighter per horsepower, but economy has been sacrificed in order to reduce the weight, and the famous Gnome engine requires 0.89 pound of fuel per brake horsepower hour, as compared with 0.54 pound for a good automobile engine.

* Associate Editor of MACHINERY.

CUTTING FRACTIONAL SCREW THREADS*

By MARTIN H. BALL†

It is not always an easy matter to know exactly what gears should be used when cutting a fractional thread. For such work as this the writer has compiled the following tables, which should be of value to machinists in general. The numbers given in the upper row and left-hand column of these tables correspond to the numbers of teeth in the change gears of lathes having lead-screws with four, five and six threads per inch, respectively. It has been found sufficient to carry the calculations to four decimal places as this seems to be practical for all purposes.

TABLE I. RATIOS FOR CUTTING FRACTIONAL THREADS

For Lead-screws Having 4 Threads per Inch

	28	32	40	42	48	56	72	80	88	96	105	112
28		0.8750	0.7000	0.6666	0.5833	0.5000	0.3888	0.3500	0.3181	0.2916	0.2666	0.2500
32	1.1428		0.8000	0.7619	0.6666	0.5714	0.4444	0.4000	0.3613	0.3636	0.3047	0.2857
40	1.4285	1.2500		0.9523	0.8333	0.7142	0.5555	0.5000	0.4545	0.4166	0.3809	0.3571
42	1.5000	1.3125	1.0500		0.8750	0.7500	0.5833	0.5250	0.4772	0.4375	0.4000	0.3750
48	1.7142	1.5000	1.2000	1.1428		0.8571	0.6666	0.6000	0.5454	0.5000	0.4571	0.4285
56	2.0000	1.7500	1.4000	1.3333	1.1666		0.7777	0.7000	0.6363	0.5833	0.5333	0.5000
72	2.5714	2.2500	1.8000	1.7142	1.5000	1.2857		0.9000	0.8181	0.7500	0.6857	0.6428
80	2.8571	2.5000	2.0000	1.9047	1.6666	1.4285	1.1111		0.9090	0.8333	0.7619	0.7142
88	3.1428	2.7500	2.2000	2.0952	1.8333	1.5714	1.2222	1.1000		0.9166	0.8380	0.7857
96	3.4285	3.0000	2.4000	2.2857	2.0000	1.7142	1.3333	1.2000	1.0909		0.9142	0.8571
105	3.7500	3.2812	2.6250	2.5000	2.1875	1.8750	1.4583	1.3125	1.1931	1.0937		0.9375
112	4.0000	3.5000	2.8000	2.6666	2.3333	2.0000	1.5555	1.4000	1.2727	1.1666	1.0666	

TABLE II. RATIOS FOR CUTTING FRACTIONAL THREADS

For Lead-screws Having 5 Threads per Inch

	20	25	30	35	40	45	46	50	55	60	65	70	75	80	90	100	110
20		0.8000	0.6666	0.5714	0.5000	0.4444	0.4347	0.4000	0.3636	0.3333	0.3076	0.2857	0.2666	0.2500	0.2222	0.2000	0.1818
25	1.2500		0.8333	0.7142	0.6250	0.5555	0.5434	0.5000	0.4545	0.4166	0.3846	0.3571	0.3333	0.3125	0.2777	0 2500	0.2272
30	1.5000	1.2000		0.8571	0.7500	0.6666	0.6521	0.6000	0.5454	0.5000	0.4615	0.4285	0.4000	0.3750	0.3333	0.3600	0.2727
35	1.7500	1.4000	1.1666		0.8750	0.7777	0.7608	0.7000	0.6363	0.5833	0.5384	0.5000	0.4666	0.4375	0.3888	0.3500	0.3181
40	2.0000	1.6000	1.3333	1.1428		0.8888	0.8695	0.8000	0.7272	0.6666	0.6153	0.5714	0.5333	0.5000	0.4444	0.4000	0.3636
45	2.2500	1.8000	1.5000	1.2857	1.1250		0.9782	0.9000	0.8181	0.7500	0.6923	0.6428	0.6000	0.5625	0.5000	0.4500	0.4090
46	2.3000	1.8400	1.5333	1.3142	1.1500	1.0222		0.9200	0.8363	0.7666	0.7076	0.6571	0.6133	0.5750	0.5111	0.4600	0.4181
50	2.5000	2.0000	1.6666	1.4285	1.2500	1.1111	1.0826		0.9090	0.8333	0.7692	0.7142	0.6666	0.6250	0.5555	0.5000	0.4545
55	2.7500	2.2000	1.8333	1.5714	1.3750	1.2222	1.1956	1.1000		0.9166	0.8461	0.7857	0.7333	0.6875	0.6111	0.5500	0.5000
60	3.0000	2.4000	2.0000	1.7142	1.5000	1.3333	1.3043	1.2000	1.0909		0.9230	0.8571	0.8000	0.7500	0.6666	0.6000	0.5454
65	3.2500	2.6000	2.1666	1.8571	1.6250	1.4444	1.4130	1.3000	1.1818	1.0833		0.9285	0.8666	0.8125	0.7222	0.6500	0.5909
70	3.5000	2.8000	2.3333	2.0000	1.7500	1.5555	1.5217	1.4000	1.2727	1.1666	1.0769		0.9333	0.8750	0.7777	0.7000	0.6363
75	3.7500	3.0000	2.5000	2.1428	1.8750	1.6666	1.6304	1.5000	1.3636	1.2500	1.1538	1.0714		0.9375	0.8333	0.7500	0.6818
80	4.0000	3.2000	2.6666	2.2857	2.0000	1.7777	1.7391	1.6000	1.4545	1.3333	1.2307	1.1428	1.0666		0.8888	0.8000	0.7272
90	4.5000	3.6000	3.0000	2.5714	2.2500	2.0000	1.9565	1.8000	1.6363	1.5000	1.3846	1.2857	1.2000	1.1250		0.9000	0.8181
100	5.0000	4.0000	3.3333	2.8571	2.5000	2.2222	2.1739	2.0000	1.8181	1.6666	1.5384	1.4285	1.3333	1.2500	1.1111		0.9090
110	5.5000	4.4000	3.6666	3.1428	2.7500	2.4444	2.3913	2.2000	2.0000	1.8333	1.6923	1.5714	1.4666	1.3750	1.2222	1.1000	

To illustrate the use of the accompanying tables, we will take a practical example: Assume that it is necessary to cut a worm having a lead equal to 0.194 inch, and that the number of threads on the lead-screw is four per inch. Then the lead of the lead-screw expressed in decimals will be 0.250 inch; therefore, the ratio of the gearing required is 194 to 250 and we find the ratio is $\frac{250}{194}$ or 1.2886. Referring to Table I, we find that 56 into 72 gives a ratio of 1.2857, which is the nearest decimal we can find in the table. But the following method of proving the above shows that the amount of error is very slight.

For example: $\frac{56 \times 0.250}{72} = 0.1944 +$ which is less than 0.0004 inch too long in lead; but this is usually close enough for ordinary practice.

To give another example, we will say that it is necessary to cut a worm which is to run in mesh with an 8 diametral pitch gear, the circular pitch of which is 0.393 inch. Then the ratio is $\frac{250}{393} = 0.6361$. Referring to Table I we find that the nearest decimal is 0.6363, which calls for an 88 into a 56 gear, this giving a lead of 0.3928 +, which is less than 0.0002 inch too short.

To give another example, we will say that 48 threads per inch are required, and the ratio is found to be 12. Not finding this in Table I, it is apparent that compounding the gears will have to be resorted to. Referring to Table I, we find ratios 4 and 3, and $4 \times 3 = 12$. The ratio of 4 calls for a 28 into a 112 gear, and the ratio 3 for a 32 into a 96 gear, which are the required gears to produce a lead of 48 threads per inch. It can be seen, therefore, that the compounding of the gears is just as simple as using the single driver and driven gears.

Another method that can often be used to advantage is as follows: In a case where 24 threads per inch are required, the ratio between the lead-screw and the screw to be cut (when the number of threads in the lead screw is four per inch) is $\frac{24}{4} = 6$. Referring to Table I, we find that 32 into 96 gives a ratio of 3 and that 40 into 80 gives a ratio of 2, thus, $2 \times 3 = 6$. This latter method of using fractions instead of decimals is sometimes shorter and more convenient. Tables II and III are made up on the same principle as Table I, for lead-screws of five and six threads per inch, respectively.

TABLE III. RATIOS FOR CUTTING FRACTIONAL THREADS

For Lead-screws Having 6 Threads per Inch

	24	28	32	36	40	44	48	52	56	60	64	68	72
24		0.8571	0.7500	0.6666	0.6000	0.5454	0.5000	0.4615	0.4285	0.4000	0.3750	0.3529	0.3333
28	1.1666		0.8750	0.7777	0.7000	0.6363	0.5833	0.5384	0.5000	0.4666	0.4375	0.4117	0.3888
32	1.3333	1.1428		0.8888	0.8000	0.7272	0.6666	0.6153	0.5714	0.5333	0.5000	0.4705	0.4444
36	1.5000	1.2857	1.1250		0.9000	0.8181	0.7500	0.6923	0.6428	0.6000	0.5625	0.5294	0.5000
40	1.6666	1.4285	1.2500	1.1111		0.9090	0.8333	0.7692	0.7142	0.6666	0.6250	0.5882	0.5555
44	1.8333	1.5714	1.3750	1.2222	1.1000		0.9166	0.8461	0.7857	0.7333	0.6875	0.6470	0.6111
48	2.0000	1.7142	1.5000	1.3333	1.2000	1.0909		0.9230	0.8571	0.8000	0.7500	0.7058	0.6666
52	2.1666	1.8571	1.6250	1.4444	1.3000	1.1818	1.0833		0.9285	0.8666	0.8125	0.7647	0.7222
56	2.3333	2.0000	1.7500	1.5555	1.4000	1.2727	1.1666	1.0769		0.9333	0.8750	0.8235	0.7777
60	2.5000	2.1428	1.8750	1.6666	1.5000	1.3636	1.2500	1.1538	1.0714		0.9375	0.8823	0.8333
64	2.6666	2.2857	2.0000	1.7777	1.6000	1.4545	1.3333	1.2307	1.1428	1.0666		0.9411	0.8888
68	2.8333	2.4285	2.1250	1.8888	1.7000	1.5454	1.4166	1.3076	1.2142	1.1333	1.0625		0.9444
72	3.0000	2.5714	2.2500	2.0000	1.8000	1.6363	1.5000	1.3846	1.2857	1.2000	1.1250	1.0588	

* * *

The mathematical symbols + (plus) and — (minus) first appeared in a German work published in 1489; = (equals) in another German work in 1557; > (is greater than) and < (is less than) in the works of Harriott (1560-1621); and × (multiplied by) in a work by Oughtred (1574-1660).

* For additional information on cutting fractional screw threads, see MACHINERY, November, 1903, and MACHINERY'S Reference Series Pamphlet, No. 32, "Screw Thread Cutting."

† Address: 293 5th Ave., Watervliet, N. Y.

MACHINING SHAPER RAMS

By ETHAN VIALL*

The way shaper rams are routed through the shop of the Queen City Shaper Co., Cincinnati, Ohio, is to first rough center them by marking with compasses and a prick punch and then drill and countersink them, after which they are each placed in a lathe, as in Fig. 1, the heads turned and finished and the circular T-slot *A*, cut. For handling heavy rams, an eye-bolt, *B*, is screwed into the slot for the hoist hook. The two drivers *C* serve also as brackets to steady the ram while placing it on the lathe centers. After finishing the head, the rams are placed three at a time on a planer, the top of the slides roughed off and the top of the slots surfaced off and finished, as in Fig. 4, after which they are placed six at a time on the

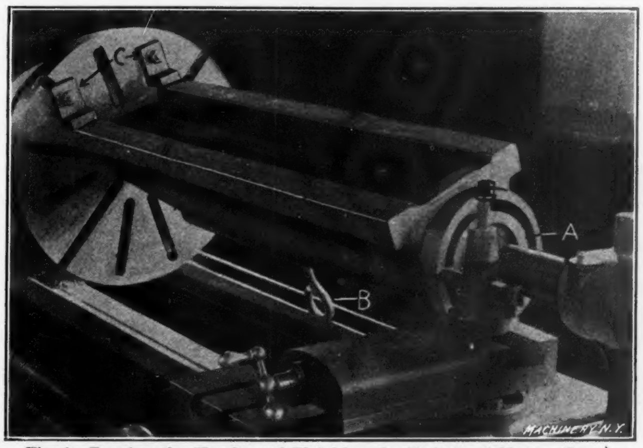


Fig. 1. Turning the Heads and Finishing the T-slots of Shaper Rams

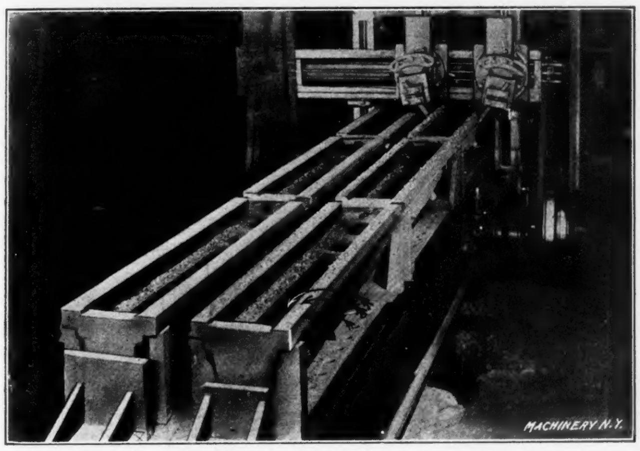


Fig. 2. Finishing the Bottom and Sides of Shaper Rams on the Planer

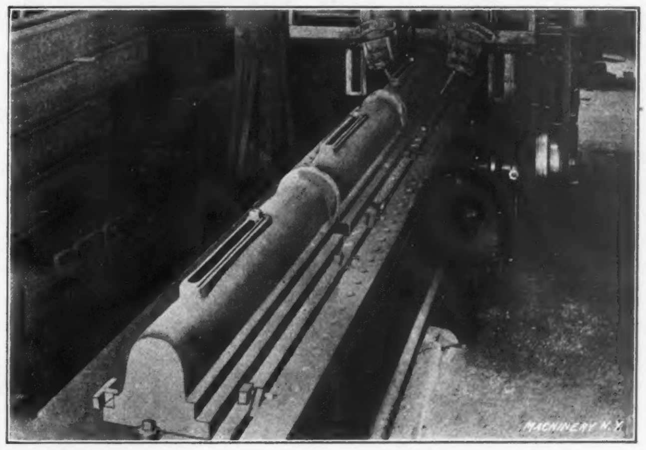


Fig. 3. Taking the Finishing Cuts on the Slides, Three at a Time

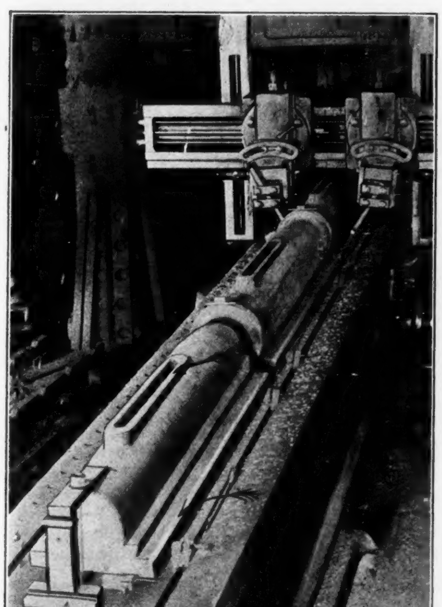


Fig. 4. Roughing the Top of the Slides and Finishing the Slots

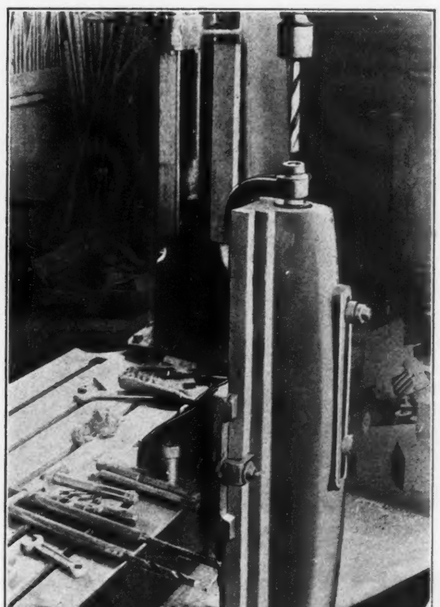


Fig. 5. Drilling, Reaming and Facing the Long Screw Holes in the Rams

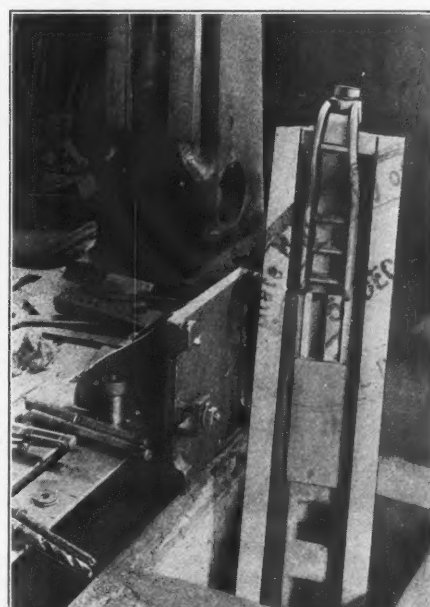


Fig. 6. Bracket used in Holding the Shaper Ram on the Drill Press

planer, being set into brackets as shown in Fig. 2, and the sides, bottoms and bottoms of the slots, as shown by the arrows, are roughed and finished at one setting. Again the rams are placed bottom down, three at a time, on the planer, Fig. 3, and the tops of the slides carefully finished, care being taken to so set and clamp the work as to avoid springing it. The tops of the slots having been finished in the first operation are not touched in this.

From the planer the rams go to a Fosdick radial drill, Fig. 5, and are clamped in a special bracket, the head resting in the bottom of the pit, and the long screw holes are drilled, reamed and faced with a counterbore, on each end. Fig. 6 shows the bracket for holding the ram and the manner of setting it on the drill jig, which is lined up by and clamped to the finished slot. Next, the hole for the ram-adjusting shaft is drilled, as shown in Fig. 7, the ram being set on angle blocks. The drilling jig for this operation is lined up and clamped to the finished slot in the same way as was the jig shown in Fig. 6, and in this way the two holes always bear a definite relation to each other.

Fig. 8 shows the jigs in which the links are drilled, bored and reamed, the boring-bar and reamer being supported by bushings on both sides of the hole.

The tool slides are drilled in the jig shown in Fig. 9 and then the swivel is slipped on the dovetail ways and the slide clamped to the angle-plate jig, as shown in Fig. 10, a drill bushing being used in the hole just drilled in order to line up the holes in the two parts correctly.

*Associate Editor of MACHINERY.

THAT NEW JOB

By K. P. C.

I thought at the time it was the one important event of my life, and although other things of some importance have since happened, such as losing a good job in mid-winter a thousand miles from home after spending all my money for a new winter outfit, having someone cut me out of my best girl, getting married, etc., I still consider it of some moment. It was one of the proudest times of my life—even though my pride was soon doomed to fall.

I had finished my time and was now a full-fledged machinist with a brand-new tool-box in my possession, containing most of the tools listed in a tool catalogue, and was on my way to work at a new shop which paid the best wages in that locality. I lasted just half a day.

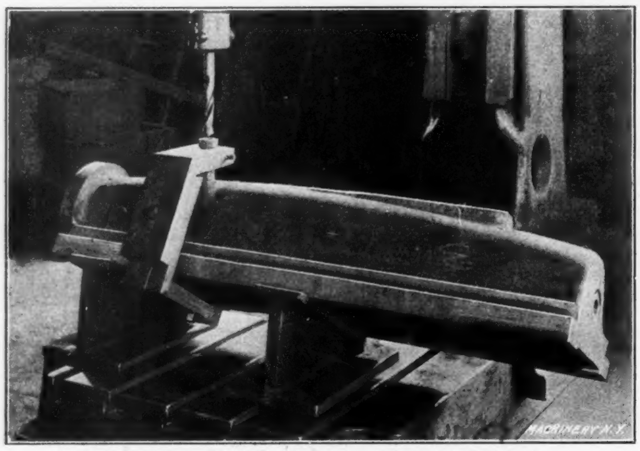


Fig. 7. Drilling the Holes for the Ram-adjusting Shaft in a Fosdick Radial Drill Press

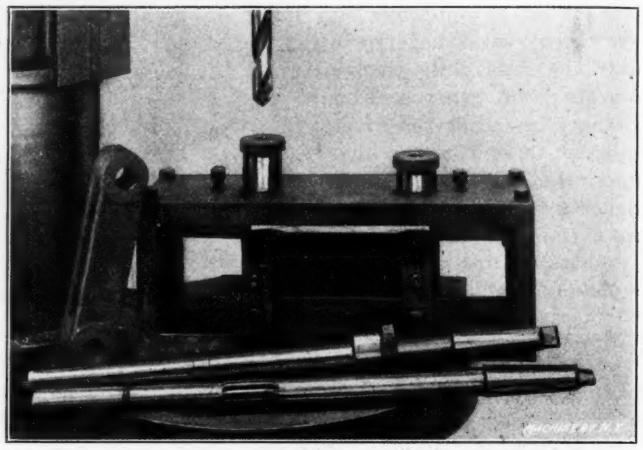


Fig. 8. Jigs used in Drilling, Reaming and Boring the Links

It was not because I was incompetent to hold that job either —it was just nervousness. In the shop where I had served my time, all we had to do was our own repair and tool work; we had from one to three extra men all the time for break-down jobs, so ordinarily we were not rushed. This class of work had given me a wide range of experience, but it was not the kind to accustom an apprentice to make time on new work, and my new job was in a shop where speed was demanded. The foreman put me on a lathe and stood watching me for five or ten minutes. That, alone, gave me a bad start, and I soon saw I was not making the time the others were. In trying to keep up with the others, I spoiled the work and lost my job.

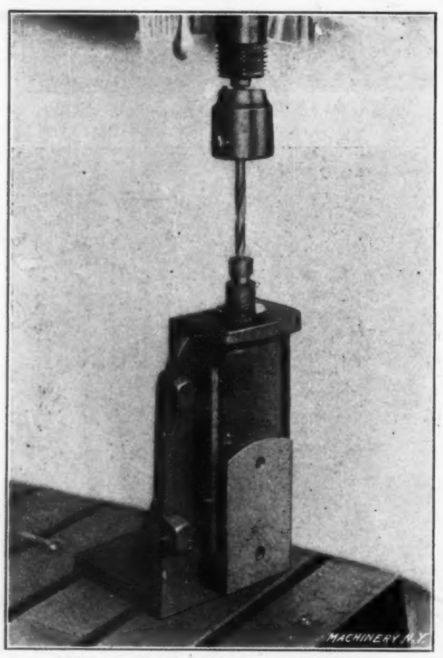


Fig. 9. Jig in which the Tool Slides are drilled

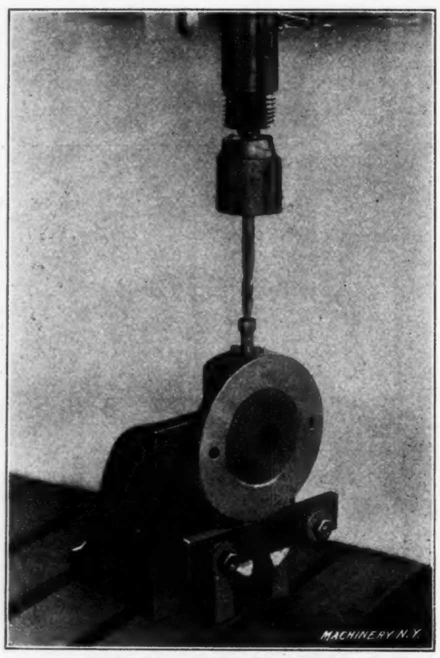


Fig. 10. Drilling the Holes in the Swivel in Correct Relation to the Hole in the Tool Slide

As I was packing up my tools an old machinist I knew came over and gave me some advice which has since proved to be first-class. "Boy," he said, "you are never expected to make the time on your first day in a strange shop that the old men do, but you are expected to do a good job, and if you do that in a reasonable amount of time you will soon be able to make the speed. Another thing, if the foreman rubbers at you like this one did this morning, don't start while he is there—oil your machine well, look for some tool, and if he is still there, ask him where the water is, and go get a drink. This will give you a chance to find yourself and to see how the other machines are running on the same class of work." When I applied for my next job I followed his advice and was successful.

Some foremen make a practice of giving a new man what they call a "test," that is, they pick out the hardest job they have and give that to him, and if he is successful with it he is a good man. I knew a locomotive pit boss who always gave new men shoes and wedges, and if they could lay them out they were machinists.

In one shop I was given an inside, double, left-hand, square thread to cut. The lathe was an old one and I had to take up some lost motion in it, figure out the gears, get tools dressed, etc., in fact there was a lot of preliminary work to do before I could start on the job. I do not remember how long I was on it, but I made good and satisfied the foreman. Now there was nothing really difficult about that job, and I was capable of doing it at the time I lost my first job, but a little nervousness would have spoiled it, as it did in the first case.

The differing requirements for work in various shops is another thing a new man has to contend with; one wants a nice finish—another doesn't care so long as the workmanship is good. Most shops have certain ideas about work that you do not agree with, but it is not good policy for a new man to criticise them. I remember one shop that used lard oil for lubricating. Although I considered this poor practice, I used it and said nothing —it was their business, not mine; and so with everything.

In brief, a new man must be guided by circumstances, do what he does right, avoid getting nervous, and not go to the other extreme of trying to tell people in his first day how to run a business which they have spent years and money building. In the words of a successful master-mechanic, "A good man does as he is told to do."

* * *

Cylinder oil may be tested by heating it and noting its color. A good cylinder oil will not change color to any noticeable degree when heated to 480 degrees F., or a temperature higher than that existing in a high-pressure engine cylinder. Low-grade oils, however, will darken when heated to this temperature.

CUTTING KEYWAYS IN AN AUTOMATIC SCREW MACHINE

By S. N. BACON

Very few mechanics and engineers are aware of the possibilities of the automatic screw machine, for different reasons, one of which is that when an odd job is tried and successfully made it is regarded as a discovery and a secret, and the fellow who dares to write about it, is in danger of being discharged; in the meantime our competitor over in the next town, has been using this same device for years and he also is very careful not to let the secret out.

In this article the writer will describe the making of the pieces shown at *A*, *B* and *C*, Fig. 1, in the automatic screw machine. The cutting of the keyway is most interesting, so it will be described first. To those who have doubts

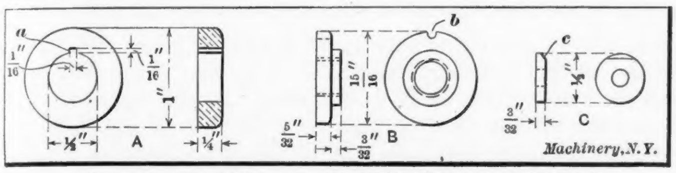


Fig. 1. Pieces which were successfully shaved in a Brown & Sharpe Automatic Screw Machine

as to whether these jobs worked successfully the writer will say that the material was in all cases soft brass, and that the keyway in the piece *A*, was given a limit of 0.005 inch. This piece was made from 1-inch diameter round brass rod in a No. 2 Brown & Sharpe automatic screw machine, and it was manufactured in large quantities to be used in lathe construction. The hole was not reamed, as the drill cut a hole smooth enough for the use to which it was put. The surface speed of the drill was 157 feet per minute and the surface speed of the external diameter of the stock was the same.

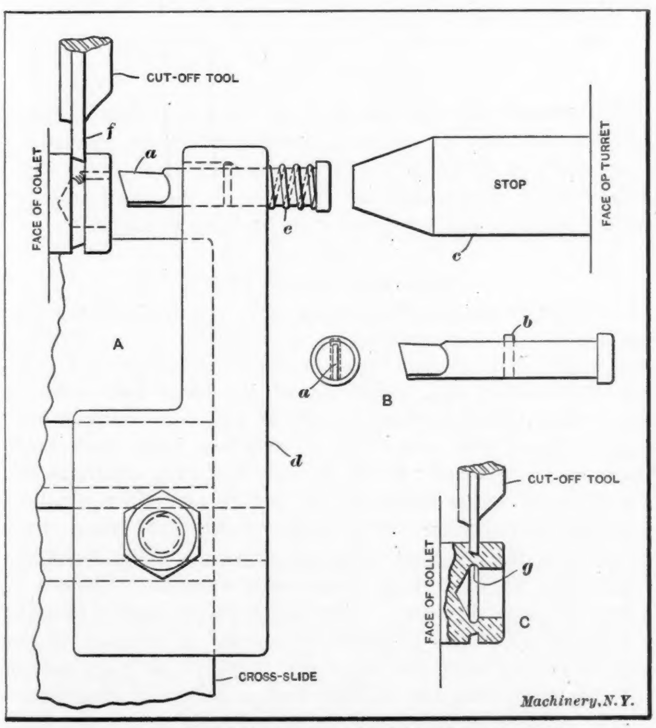


Fig. 2. Tools and Method used in Cutting the Keyway in the Piece shown at A, Fig. 1

The reason for this is that the stock is twice the diameter of the drill and the fast spindle speed, which is 1200 revolutions per minute, is twice that of the slow speed, which is 600 revolutions per minute. It should be mentioned here that a Brown & Sharpe spindle brake was used in connection with this operation and the belt-shifting attachment also, which gave the two spindle speeds 600 and 1200, respectively. This belt-shifting attachment was described in the June number of MACHINERY, so it will not be necessary to mention it further.

We will now describe the shaving tool and the operation of shaving the keyway. The tool-holder and shaving tool used for this operation are shown at *A* in Fig. 2, and a clearer view of the shaving tool itself is shown at *B*. This tool is made rectangular at the cutting edge *a* and is also given a slight top rake. A small pin *b* is inserted in it which prevents it from rotating in the holder. The tool is shown assembled in the holder at *A* and it can be seen that a small spiral spring *e* is used to keep the tool back from the work until it is operated on from the turret.

In operation the front cross-slide cam moves the cutter forward until the cutting point has reached a point where it will shave a chip 0.0205 inch thick. The stop *c*, which is held in the turret now moves forward pushing the cutter through the holder *d*, and into the work. Then the stop *c* is withdrawn and the coil spring *e* returns the cutter to position for another cut. The front-slide is now advanced until the cutter is in position to take another cut 0.021 inch thick and the same operation is repeated until the keyway 1/16 inch deep is cut. This is performed by three movements of the shaving tool. It will be noticed that the cut-off tool *f* is of sufficient width to allow the hole in the piece to be drilled deep enough so that the shaving tool will have plenty of room to pile up the chips. If this were not provided for, the chips would pile up ahead of the tool and break the point.

A method could be used as shown at *C* so that the blade of the cut-off tool would not be as thick as at *f*; in this case the hole could be recessed as shown at *g* so as to leave plenty of chip-room. The peculiar shape at the bottom of the hole is made by the point of the drill and the recessing tool. The shaving tool is very cheaply made and is sharpened by grinding on the end. If desired the pin *b* could be dispensed with by leaving a ring at this point when turning the shaving tool, and milling the ring away, except the part which would fit in the slot; but the pin, however, is more easily made and also simplifies replacing when broken. The order of operations to make this piece is as follows

TURRET OPERATIONS

(Spindle Speed, 1200 R. P. M.)

Order of Operations	Revolutions	Hundredths
Feed stock to the stop and chuck.	44	0 to 4
Revolve the turret	33	4 to 7
Center 0.250 inch rise at 0.007 inch feed	44	7 to 11
Revolve the turret	33	11 to 14
Drill 0.310 inch rise at 0.0065 inch feed	44	14 to 18
Revolve the turret and shift to dead pulley, held by spindle brake	33	18 to 21
Push in shaving tool on front-slide with stop held in turret	33	23 to 26
Return and push in shaving tool 2nd cut	55	26 to 31
Return and push in shave tool 3rd cut	55	31 to 36

FRONT CROSS-SLIDE OPERATIONS

(Spindle Speed, 1200 R. P. M.)

Order of Operations	Revolutions	Hundredths
Bring forward shaving tool on front-slide so it will shave 0.0205-inch chip	22 (49.5)	21 to 27½
Advance shaving tool 0.021 inch	(55.0)	27½ to 32½
Advance shaving tool 0.021 inch	11 (38.5)	32½ to 37

REAR CROSS-SLIDE OPERATIONS

(Spindle Speed, 600 R. P. M.)

Order of Operations	Revolutions	Hundredths
Cut off 0.530 inch rise at 0.00152 inch feed	693	37 to 100
Revolve turret 3 times while cutting off	(99)	(9)

The total number of revolutions to complete one piece equals 1100; number of seconds equals 55; gross product, 654; net product, 574; gears used, 60 driver, 60 first on stud, 42 second on stud and 77 on the worm shaft.

In Fig. 3 is shown a lay-out of the cams and it will be seen that the most interesting part is from 21 to 36 hundredths on the cam circle, this part being used for shaving the keyway. At the hundredths line marked 21 is seen a dotted line

which is the rise of the front cross-slide cam, this bringing the shaving tool to its forward position 0.0205 inch past the edge of the hole. When in this position the cross-slide dwells, while the stop in the turret pushes the shaving tool which is operated by that part of the cam shown by the full line from 23 to 36 hundredths, inclusive. It is necessary to keep the shaving tool on a dwell until the stop in the turret has receded; this is shown on the cam outline.

The lock-nut shown at *B* in Fig. 1 is another interesting piece on which expense was saved by using a shaving fixture in the automatic screw machine. This piece has the groove at *b* shaved in it to be used as a catch, for tightening the nut with a spanner wrench. As this piece is similar to the one just described it will not be necessary to dwell on the method of shaving. The order of operations is as follows:

Order of Operations	Revolutions	Hundredths
Feed stock to stop	18	3
Revolve turret	18	3
Center 0.180 inch rise at 0.006 inch feed	29	5
Revolve turret	18	3
Drill 0.300 inch rise at 0.006 inch feed	59	10
Form 0.130 inch rise at 0.001 inch feed	130	22
Revolve turret	18	3
Tap in	18	3
Tap out	18	3
Revolve turret	18	3
Stop spindle and bring forward shaving tool for 0.020 inch chip	18	3
Shave 0.200 inch	35	6
Bring forward 0.020 inch	18	3
Shave 0.200 inch	35	6
Return and bring forward 0.020 inch	18	3
Shave 0.200 inch	36	6
Clear, start spindle	18	3
Cut-off 0.400 inch rise at 0.002 inch feed	200	34
	592	100

The spindle revolutions used are 789 R. P. M. backward and forward. The time to make one piece is 45 seconds, the gross product in 10 hours is 800 and the net product is 700.

Another piece which is shaved in an entirely different manner is shown at *C*, Fig. 1. In this case the piece was made on a No. 0 Brown & Sharpe automatic screw machine. Considerable trouble was first experienced with this job but eventually it was worked out successfully. The material from which the piece was made is ½ inch diameter soft brass rod and the shaving operation consisted in removing the corner at *c*. The difference in the method of making this piece and those previously described is that the shaving tool and holder are held in the turret instead of on the cross-slide. The holder used for this operation is shown in Fig. 4, where *a* is the shank which fits in the turret, and inserted into it, as shown, is the shaving tool *b*. This tool is made spherical in shape and is ground on the end as shown. It also has a small pin *c* inserted in it to prevent it from turning in the holder, and is actuated by means of the small spiral spring *d*. The spindle brake, of course, is used in connection with this operation, but as only one spindle speed is used, it is not necessary to use the belt-shifting attachment. The tool is operated by the toolpost carried on the cross-slide. As this operation is somewhat similar to those described, it will be sufficient to give the order of operations only. They are as follows:

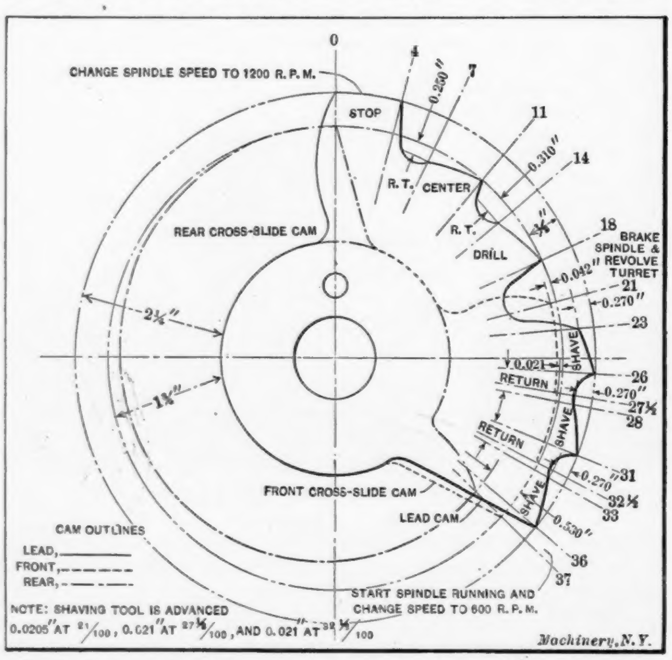


Fig. 3. Lay-out of the Cams used in Making the Piece shown at A in Fig. 1

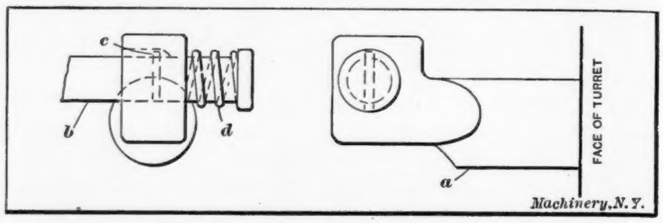


Fig. 4. Tool and Holder used in Shaving the Piece shown at C in Fig. 1

Order of Operations	Revolutions	Hundredths
Feed stock to stop	20	4½
Revolve turret	22	5½
Center 0.060-inch rise at 0.003-inch feed	20	4½
Revolve turret	22	5½
Drill 0.080-inch rise at 0.004-inch feed	20	4½
Revolve turret	22	5½
Stop spindle and bring shaving tool forward to cut 0.020 inch	15	3½
Shave 0.0250 inch	20	4½
Withdraw front-slide and advance shaving tool 0.020 inch	15	3½
Shave 0.250 inch	22	5½
Clear and start spindle	22	5½
Cut-off 0.270-inch rise at 0.002-inch feed	132	31½
Revolve turret 3 times while cutting off	66	16
	418	100

The spindle speed was 1474 R. P. M. The total time to make one piece equalled 17 seconds; gross product or number of pieces made in 10 hours, 2117; net product, 1900 pieces. The surface speed of the external diameter of the stock was 193 feet per minute, and for drilling, 48 feet per minute.

* * *

FLEXIBLE COUPLINGS

Couplings of some flexibility are often required for coupling together electrical machinery, or for coupling electric to other machinery. Two general types of flexible couplings are available—the leather link coupling and the laced belt coupling. The leather link couplings consist of two iron castings with flanges which are connected by leather links and bolts. The bolts are generally six in number and each alternate bolt is fitted tight in the flange of one casting and given considerable play in the other. The leather links then extend from each bolt to the one next to it, and provide a slight flexibility in driving. This coupling is especially adapted for shafts up to 3½ inches in diameter. The leather laced flexible coupling is adapted for shafts of larger diameter. It consists of two steel rings, one outer and one inner, in which slots are formed and through which two endless leather belts are interwoven. This coupling possesses great flexibility, and as the two rings are concentric, there are no bending strains.

* * *

Some tests have recently been made on a new alloy called duralumin, mentioned in the October number (engineering edition), brought out by Messrs. Vickers, Sons, and Maxim, Ltd. According to the *Practical Engineer*, London, the specific gravity is somewhat less than one-third of that of cast iron, and the tensile strength is equal to that of good mild steel. It is said that the alloy is not suitable for castings, but is used for sheets and plates. The ductility is fairly good in moderately thick plates, but falls off in thin sheets. The yield point is about one-half of the maximum strength in thin sheets.

THE EXPERIENCES OF A YOUNG TOOLMAKER*

By T. COVEY

"What is the matter, Jim? You look as if you had lost your last friend," said George, as Jim came up with a very long face.

"I'm in for it now," replied Jim.

"What is the trouble?"

"Mr. Corbin gave me this piece to make and I have spoiled it. He won't do a thing to me when he finds it out."

"Oh, I don't know. Mr. Corbin will be fair with you. He realizes that anyone is liable to make mistakes. What is wrong with the piece?"

"I've got this slot in it too wide. I had it all done but running a finish cut over the sides of the slot and was going to leave about two thousandths inch to finish by scraping. I had one side finished all right and the next to the last cut over the other side left the slot about five thousandths inch too narrow. I thought that by leaving the tool set as it was and running the cut up again I would have it about right. After I had gone about a half inch up from the bottom I tried this little gage that I had made, in it and it was just right, so I finished the cut; now the thing is all right at the bottom and four thousandths too wide at the top—and he told me to be particular and get it to the right width."

"That is too bad," said George, "but it can probably be fixed up all right."

"I don't see how," said Jim. "The stock is gone and that is all there is to it. What can be done with it now?"

"Well, if I had the job of fixing it up I should take a saw about an eighth inch thick and cut a slot alongside of that one and then plane up a strip enough thicker than the saw to make up the amount the large slot is too wide; then force the strip into the saw slot and solder it there, thus bending the stock between the saw slot and the large slot over towards the

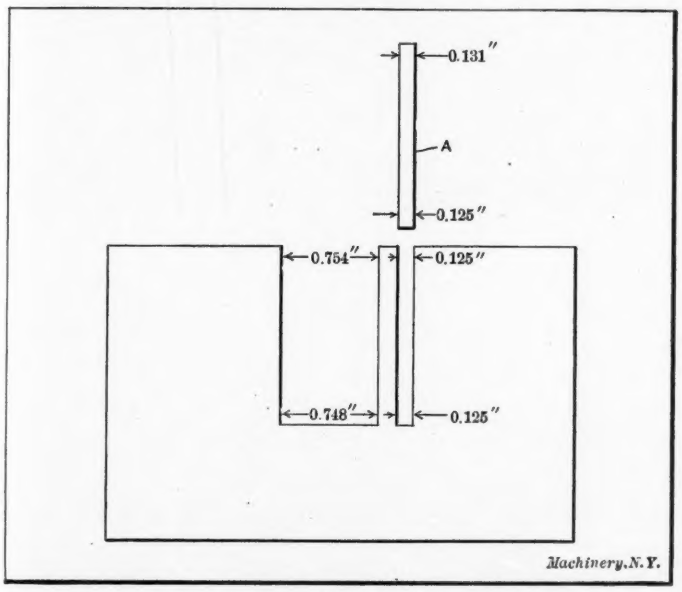


Fig. 1. The Spoiled Piece and the Way it was made Good

large slot and leave it so that it could be scraped up to the size that you want it. With a little care it could be done so that it would not show afterwards."

"I'll do that," said Jim.

"You had better show it to Mr. Corbin first and see what he says about it."

"Hard luck," said Jim as he walked away. About an hour afterward George came up to where he was puttering around at his vise and asked him what Mr. Corbin had said about it.

"I have not told him yet," said Jim. "I guess that I will finish it up and turn it in as it is."

"That is no way to do; if you leave it for him to find out, you will put yourself in a good way to get a lecture that you will remember for some time. Go tell him now and have it over with."

"I guess I will. I am in for it, and I may as well take it now as later," and he picked up the piece and, going up to Mr. Corbin's desk, said: "I have spoiled this piece, Mr. Corbin."

"How is that?" asked Mr. Corbin.

"I made this slot too wide," he replied, and went on and explained how it came about.

"Well, what will we do with it now?"

"Couldn't I take a saw and cut a narrow slot alongside of this one and put a piece in it enough thicker than the width of the saw slot to make up what I need to finish it properly?"

"I don't like patched-up jobs, but I want that pretty soon, and you could fix it much quicker than you could make an-

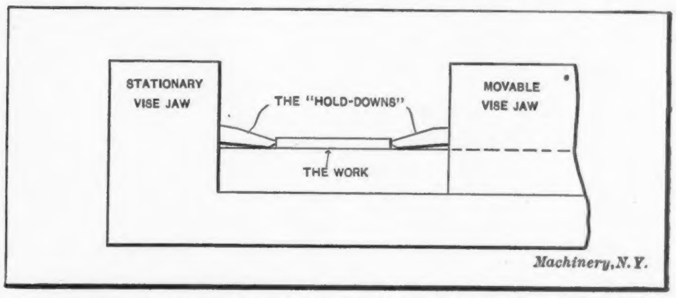


Fig. 2. Showing Use of "Spuds" or "Hold-downs" for Thin Planer Work

other. It is not going out of the toolroom anyway, so go ahead and see what you can do with it."

Jim took the piece back and told George that Mr. Corbin said that he did not like patched-up jobs, but to go ahead and fix it. "How far away from the slot should I cut in with the saw?" he asked.

"I should say about three-sixteenths inch. It is cast iron and you don't want to get too close. It is a good thing that the bottom of the slot is all right; now all you have to do is to make your piece that you put in slightly wedge-shaped and put the thin edge to the bottom; that will crowd the top over and leave the bottom as it is."

Jim got a large saw about 1/8 inch thick and cut a slot in the piece so that it looked like Fig. 1. (The patch properly dimensioned and ready to put in is shown at *A*.) Then he found a piece of cast iron that would plane up about 1 1/4 inch by 3 inches and a little thicker than 1/8 inch, which was what he wanted. He got the length and width planed up so that when put in place it would project slightly all around to allow for trimming off evenly with a file and scraper, but when he came to plane up the thickness he had considerable trouble holding it, as it was so thin, and he went over to George and asked him how he held such work.

"I have a couple of little strips here I call 'hold-downs' that I use on such work as that. All you have to do is to lay your piece on the bottom of the shaper vise and put one of these strips on each side of it and close the vise. (See Fig. 2.) They will hold it down on the bottom of the vise and firm enough so that you can plane it easily. When you take the last cut you can put paper under one edge to make that edge thinner than the other, and your piece will come out about right."

"Say, those work fine," said Jim. "Where did you get them?"

"I made them," said George. "They are fine for any work that you wish to plane parallel; and if they are hardened as those are they will last indefinitely."

"I'll have to make a pair myself," said Jim. "How will I go about it to solder that piece in place?"

"Why, get one of those small plumber's torches and heat the piece up around the slot so that it will just about melt solder, then put a little acid in the slot and with an old file thin enough to get well down to the bottom, scrape the inner surface and at the same time apply solder. In that way you can tin the inside of the slot. You should then heat the piece and tin it also; then heat both pieces until the solder will run, and press the strip in place, squeezing out the excess solder. Let the job cool, and if you have the surfaces in contact well tinned you can not drive the piece out with a sledge-hammer. This method of soldering is sometimes called sweating."

Jim got the piece patched up and the slot finished to the

* For previous instalments of this series see: "Experiences of a Young Toolmaker" in the October number, and the accompanying references.

right width without any further difficulty, and when he had filed and scraped the patch down even with the piece, it was impossible to see where it was. Going over to George, he showed it to him and said. "You would never be able to tell where it was patched if you did not know. I wish now that I had not said anything to the boss about it—he need never have known it at all."

"Don't be too sure about that; it might turn out like the farmer's boy and the pumpkin seed."

"How was that?"

"Why, a farmer gave his boy some pumpkin seed and told him to go through the corn field and in every fourth hill of every fourth row push down a couple of the pumpkin seeds with his fingers, explaining that by the time the seed came up the corn would be past the need of cultivation and the pumpkins could grow undisturbed, thus raising two crops at once. The boy worked industriously for an hour or so and then began to get tired of the task; he noticed with dismay that the supply of seed given him had not diminished perceptibly, and, coming to a large stone, was struck with a bright scheme to finish the task at once and proceeded to put it in operation. He lifted up the stone and planted the remainder of the seed under it, then went and informed his father that the seed was planted. In due time the seed came up, including those under the rock, and told a very explicit story and incidentally caused—well, ask the boy what it caused. Now, if you had said nothing to Mr. Corbin, and finished your work up as it is now and turned it in to him as completed, he would have called you up in the course of a couple of days or so, showed you the piece with the patch distinctly outlined with rust caused from the acid used with the solder and asked for an explanation. You would have felt very small while giving it and smaller still when he was through talking to you. And, incidentally, you would have dropped several points in his estimation. The full confidence of your foreman is an asset that is much more valuable than one is likely to realize, and one that can be much more easily destroyed than built up."

"Yes, but as long as the piece was patched according to my suggestion, or rather yours through me, and it is just as good for fulfilling the purpose for which it was made, what difference should it make to him whether he knew about it or not?"

"As a foreman, Mr. Corbin is responsible to his superiors for the proper execution of all work done under his supervision. For this reason we all do our work according to instructions received from or through him, and for the same reason when any deviation from his instructions caused by defective material, mistakes or carelessness becomes necessary, he should at once be informed so that he may take such action as he considers proper. It is *his* province to judge whether such irregularities are of sufficient importance to prohibit the use of the piece or whether the defect can be repaired so that the piece will perform that which is required of it. If a piece of work was to be surreptitiously patched so skillfully as to pass his inspection without detection, it would be work of which he had no true knowledge of the character and for which he would still be responsible. You can readily imagine his position if such a piece should fail in service and the failure be reported to his superiors before it was to him. He would then be called to account for something of which he had no knowledge, and the very fact that such work was done in his department without his knowledge would be very much to his discredit. Now, don't you see that in justice to your foreman any irregularities in your work should be reported to him at once?"

"Yes, I can, and I also see that it would not reflect to a man's credit to impose on his foreman in that way."

"No, nor in any other way. There is no man so perfect that he never makes mistakes, and the one that is prompt and willing to admit it when he does make a mistake and stands ready to take the consequences of it, will find that he will be much more liberally and leniently dealt with than one that tries to cover up his mistakes and shoulder the responsibility on some one else. Your foreman is the medium through which you obtain advancement. Your advancement depends entirely on his report to your employers, and it is hardly to be expected that he will try to push a man ahead that is not honest and square with him."

"That's right," said Jim, "and I thank you for helping me to fix this job up and for the talk, too," and he took the work to Mr. Corbin for his inspection.

"You have done a good job of patching," said Mr. Corbin, "but don't forget that you are learning to be a mechanic and not a doctor, and that it is much better to prevent a mistake than it is to be able to patch it up well."

* * *

CLAMPING PLANER WORK AND BORING JIGS

By ETHAN VIALL*

A simple and effective method of clamping work onto a planer table is in use in the shop of the Elgin Tool Works, Elgin, Ill., and is illustrated so plainly in Fig. 1 that little description is necessary. It will be readily seen that the ten-

Fig. 1. Method of Clamping Work on Planer Bed at Elgin Tool Works, Elgin, Ill.

dency of the clamping screws is to bind the parts down firmly onto the bed, the strain being downward. The pieces are, of course, kept from moving lengthwise by a stop in the bed.

Holes in jig plates are accurately laid out and bored as

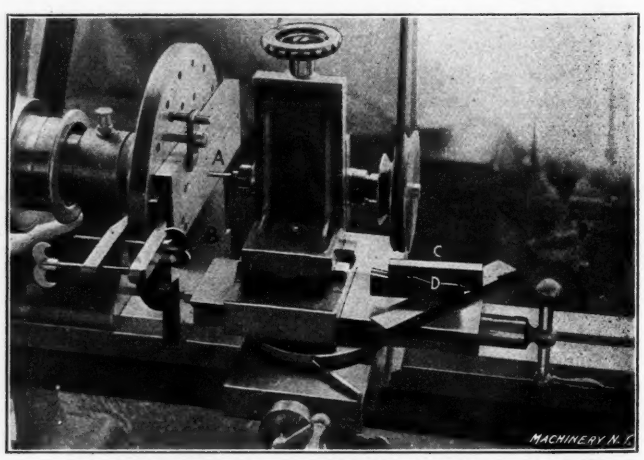


Fig. 2. Method of Laying out and Boring Jig Plates in the Elgin Tool Works

shown in Fig. 2, *A* being the jig plate to be bored and *B* an adjustable parallel block which may be set to any width within its range by using a micrometer, and adjusting and locking the two halves of the parallel in the correct position. Where required solid parallels may be used to block up, and dimensions in both directions may be obtained by using adjustable parallels on the end as well as the side of the jig

* Associate Editor of MACHINERY.

plate. Two small adjustable parallels are shown at *C*, which are locked when set in the desired position by the lock-screws *D*. The two pieces composing the parallel are held together by a T-tongue and slot, as will be seen by examining the front end of *B*.

* * *

DIAGRAM FOR FINDING CUTTERS FOR BEVEL GEARS

By V. BROCKBANK*

The accompanying diagram, Fig. 2, gives the number of cutter to be used for cutting tne teeth in bevel gears with shafts at right angles. The number of cutter given is according to the system inaugurated by the Brown & Sharpe Mfg. Co. for involute gear teeth. The method of using the diagram is very simple. Locate the number of teeth in the pinion on the right-hand side, and the number of teeth in the gear at the top of the diagram. Then follow, from the points thus located, the horizontal and vertical lines, respectively, until they intersect. The figures denoting the section of the diagram within which the lines intersect, are the numbers of the cutters to be used; where two numbers are given, the lower number in each case gives the number of cutter for the gear, the higher number, the cut er for the pinion.

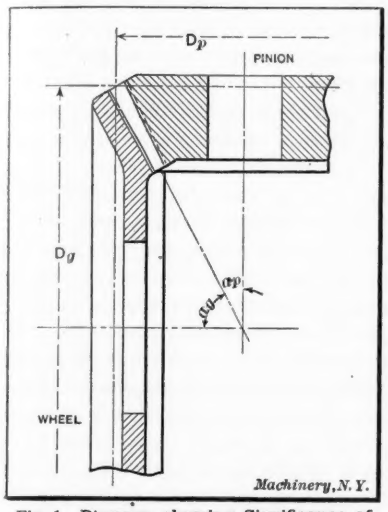


Fig. 1. Diagram showing Significance of Symbols used in Formulas

For example, assume that we are to select the cutters for a pair of bevel gears, the pinion having 24 teeth and the gear 60. Locate 24 on the right-hand side and follow the horizontal line from the point located. Also locate 60 on the top scale and follow the vertical line from this point. The two lines intersect within the area marked "1—5"; hence, a No. 1 cutter will be used for the gear, and a No. 5 cutter for the pinion.

The diagram is based on the regular bevel gear formulas, as given below:

Let D = pitch diameter,
N = number of teeth,
N' = number of teeth in equivalent spur gear for which cutter is chosen,
P = diametral pitch,
a = pitch cone angle,

When sub-letters ($_g$) and ($_p$) are used, reference is made specifically to the gear or pinion (see Fig. 1).

Then:

$$D = \frac{N}{P};\quad \tan a_p = \frac{N_p}{N_g};\quad \tan a_g = \frac{N_g}{N_p};\quad N' = \frac{N}{\cos a}$$

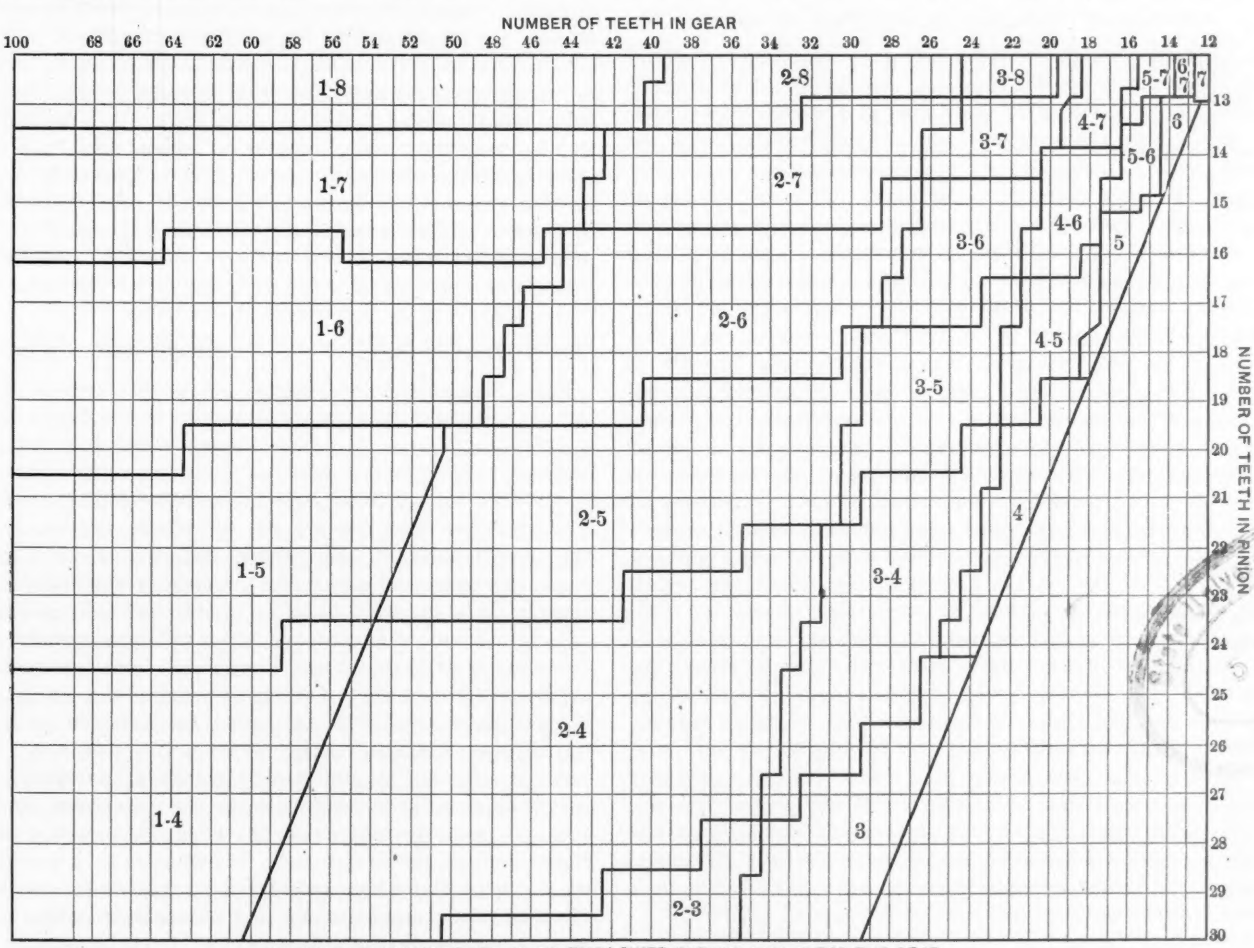
When used for spur gears,

No. 1 cutter cuts	135	teeth to	a rack
No. 2 cutter cuts	55	teeth to	134
No. 3 cutter cuts	35	teeth to	54
No. 4 cutter cuts	26	teeth to	34
No. 5 cutter cuts	21	teeth to	25
No. 6 cutter cuts	17	teeth to	20
No. 7 cutter cuts	14	teeth to	16
No. 8 cutter cuts	12	teeth to	13

When the number of teeth in the equivalent spur gear, N', is found, the numbers of cutters for cutting bevel gears are also found from the above table.

* * *

Pure platinum is too soft for many purposes, and the platinum iridium alloy used for spark-plugs, etc., is not only harder, but is more infusible than pure platinum. The alloy is made with varying percentages of iridium, containing as a rule, from 80 to 97.5 per cent of platinum and from 20 to 2.5 per cent of iridium. Commercial platinum ranges from 99.7 to 99.8 per cent pure.



WHERE TWO NUMBERS ARE GIVEN, THE LOWER IN EACH CASE IS FOR THE GEAR

Fig. 2. Diagram for Finding Cutters for Bevel Gears

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MACHINERY is published in four editions. The practical work of the shop is thoroughly covered in the Shop Edition, $1.00 a year, which comprises approximately 700 reading pages and 36 Shop Operation Sheets, containing step-by-step illustrated directions for performing 36 different shop operations. The Engineering Edition—$2.00 a year, coated paper $2.50—contains all the matter in the Shop Edition, including Shop Operation Sheets, about 300 pages a year of additional matter and forty-eight 6 x 9 Data Sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering. The Railway Edition, $2.00 a year, is a special edition including a variety of matter for railway shop work—same size as Engineering and same number of Data Sheets.

SINGLE-PURPOSE MACHINE TOOLS

In the paper on the "Design and Construction of Machine Tools from the User's Standpoint," read by Mr. John Riddell at the October meeting of the National Machine Tool Builders' Association, the desirability of a simple turning lathe for manufacturing establishments was touched upon.

In every large manufacturing plant there are scores of engine lathes used for shaft turning and similar operations, day after day. These lathes are furnished with large and small faceplates, steady-rest, lead-screw, change gears, cross-feed and other features of a complete modern engine lathe. A large part of this equipment is practically useless in manufacturing shops, and perhaps is never used during the life of the machine. Mr. Riddell has seriously considered the advisability of buying simple turning lathes without the useless adjuncts referred to, but intimated that there is no single-purpose lathe on the market that fully meets his requirements.

We feel sure that lathe builders will be glad to produce all the simple turning lathes that manufacturers require, and it can hardly be laid at their doors that it is not now a common machine tool. The fact is that most manufacturers regard their machine tool equipment as an available asset, its value being measured by the number of standard machines comprised. In other words, engine lathes, planers and other common machine tools have a well recognized market value, being available for any kind of manufacturing. They hesitate, therefore, to fill up their shops with turning lathes and other special equipment which does not, under the present conditions, have as great market value. We think that machine tool users will have no difficulty at all in inducing machine tool builders to furnish standard engine lathes, minus the unnecessary parts, provided orders for sufficient numbers are given at one time.

* * *

THE DANGER OF OVER-EXPANSION

A prosperous business may be compared to a flourishing tree. A tree's roots spread from year to year, reaching new soil and gathering more and more nourishment to the parent trunk. It grows steadily, adding a new ring each year—whether the season be wet or dry. The winter's winds may assail and the summer's sun beat fiercely down upon it, but the deep, wide-spreading roots support it and reach never-failing sources of water and nourishment. When the tree is a sapling, its roots are not deeply seated, but its needs are not great. As the trunk grows, the roots keep pace, for it is an established fact that the diameter of spread of the roots of trees growing in the open is equal to the total height.

A safe business is one that has grown healthily from year to year; its ramifications like the roots of the tree, having spread in all directions. If sales fall off in one part of the country, those from other parts may be relied on to nourish the business and keep it alive. Strength and prestige should come from age in a business, and on the other hand, one that has grown by leaps and bounds is likely to lack strength for the same reasons that apply to the trees. While it flourishes under favorable conditions it lacks foothold and balance to weather hard storms. Change in public taste, a financial crisis, or other conditions likely to develop may easily cause its downfall.

Automobile manufacturing is an industry that has grown beyond all precedent. Some concerns have sprung up like mushrooms in the night, and although originally of great size, they were unable, working day and night, to meet the phenomenal demand. The result was that they were repeatedly expanded until they have assumed enormous proportions, covering acres of ground and representing millions of dollars in investments. During the past few months evidences have appeared of a slackening demand for automobiles, and the prospects for the immediate future of some of these great manufacturing concerns are not so bright as we wish they were, although we believe that the natural and conservative development of the business, especially towards the construction of commercial vehicles, will in course of time establish it on as permanent a basis as any of our industries.

Probably the greatest temptation a business man encounters is to expand his business rapidly to meet expected demands. He realizes that he must go forward or backward, that he cannot stand still. Growth being generally regarded as synonymous with progress, it is perfectly natural to expand rapidly under favorable conditions. But the conservative business man when tempted to expand rapidly will consider carefully what the prospects are of surviving a period of hard times. It is better to turn away some business than to expand to such proportions that one bad season will ruin a business that has taken years to build up. "Make haste slowly" is still a good adage even for these strenuous times.

* * *

ACCURACY AND THE "SENSE OF VALUES"

From time to time we have called attention to the lack of accuracy in engineering calculations which has been displayed in articles submitted to us by apparently well-informed young engineers. This lack of accuracy is perhaps not entirely confined to the younger men, but it seems especially to be a shortcoming of the man recently out of college. Accuracy is the first requirement of engineering, but it may be misplaced. Some engineers and mechanics in making calculations go to an extreme of accuracy in cases where absolutely accurate results either cannot be obtained, or, if obtainable, would be unnecessary for practical requirements. In such cases too great accuracy may be a sign of careful work, but also an indication of poor judgment. This statement may require to be illustrated by an example. Assume that a girder 48 feet 4 inches between supports is subjected to a load at its center. This load is assumed to be 20,000 pounds as a maximum. It is also assumed that the safe stress in the girder must not exceed 12,000 pounds per square inch. Obviously, in a case of this kind, where the whole calculation is based on assumptions given in round numbers, it is not necessary to give the bending moment as 241,666.6 foot-pounds, or the calculated stress (assuming the moment of resistance to be 232) as 10,416.66 pounds. It simply requires an unnecessary amount of time to carry out the calculation to such close limits, and it is useless for all practical purposes. It is sufficiently close to say that the bending moment is 242,000 foot-pounds and the maximum stress 10,500 pounds per square inch.

Such approximations, of course, are permissible only when certain factors entering into the problem are based on assumptions which themselves are likely to vary to considerable degree from the actual figures in the case. The judgment required for determining to what extent such approximations are permissible or desirable comes almost wholly from experience; but as a general rule it may be said that if the calculation is based on general assumptions, or on experimental values varying between wide limits, it is sufficiently accurate, and almost always preferable, to give the answer in approximate rather than exact figures. To do so is an indication of a "sense of values"; that is, an ability to decide when and where extreme accuracy is required—a faculty for distinguishing between essentials and non-essentials.

This "sense of values" applies not only to engineering calculations. It applies to the work in the business office and to the practical shop as well. To be able to properly distinguish essentials from non-essentials is one of the prime requisites in a successful engineer or in a manager. In essence, it involves an ability to recognize under all conditions that the results accomplished are of greater importance than the system or the red tape necessary for its accomplishment; that the capacity of a machine is of greater importance than its finish; that the dimensions of parts which may be said to fit "a hole in the air" need not be accurate to one-thousandth part of an inch, etc. While accuracy is the first requirement in engineering, it is apt to be misplaced if it does not go hand in hand with a proper "sense of values."

* * *

MACHINERY MAKES OUR SUPREMACY

By J. CROW TAYLOR*

At no time, probably, more than during the past two or three years have we given the agricultural part of our country credit for representing our main source of greatness. Agricultural products have been high and we picture the farmer as being a bond-holder and riding in automobiles; and we do not stop at picturing his prosperity, but assume that he is the mainstay of the world and that the American farmer not only teaches the world, but can feed the world.

The facts and figures of to-day, however, show us plainly that our supremacy is due to machinery and not to our wonderful production in agriculture. Not that our agriculture is insignificant. It is the greatest in the world, and, by the way, its greatness is itself due to the development in the use of machinery in farming and handling farm products.

The record of exports of manufactures for the United States during the first nine months of the present year as furnished by the Bureau of Statistics at Washington not only shows that machinery and manufacturing is our great stronghold, but it furnishes evidence of its increased greatness each year and the fact that it overshadows agriculture. It is estimated that the exports of manufactures for this year will be in excess of $800,000,000 in value for the first time. For the single month of September the aggregate of export of manufactures was $70,000,000, and the figures so far this year show a large gain over last year's production and everything indicates a steady and much more rapid growth in the future.

We have two items that exceed our agricultural products or rather exceed the food-stuffs proper. One of these is crude material for use in manufacture, which includes some of our natural resources and some of the products of agriculture. Then we have manufactured stock ready for consumption. These manufactured goods represent the biggest export item of all and are practically double our immense trade in food products.

So, it is really mechanics and machinery that are responsible for our greatness, and the inventor has been a greater factor for development in the United States than has the farmer. Indeed, the inventor has been a great factor in developing our farming possibilities. If we had continued to farm as they do in old countries with primitive tools and hand labor we would never have attained anything like the greatness of the present. It took the inventors to bring this out and there is a long line of them to which much credit is due. The planters, plows, cultivators, mowers, reapers, threshers, mills, and all the mechanical apparatus used in planting, producing and handling agricultural products, have made farming what it is, and these same inventors and the machinery institutions making and handling their products that have made the United States famous have made possible our great manufactures, have made it practical to turn out manufactured products in competition with poorly paid labor in all parts of the world, made competition successful, and still paid the mechanics operat'ng the machinery more money than is paid anywhere else in the world.

So, we may grow sentimental if we will over the farm and its products and over the farmer being the backbone of the nation and the main dependence for its subsistence, but the facts and figures show that the farmer is only a secondary consideration and it is the manufacturer and machinery that comes first as a factor in the upbuilding of our nation's greatness. It is machinery and mechanics that have enabled us to dominate the world's markets and have made possible our great progress in farming. Not only that, when things are slow in the manufacturing world, when panics and depressions come there are hard times and the people suffer more perhaps than when there is a bad crop in this section or that section. Moreover, the mechanics which make possible irrigation furnish a safeguard in agriculture against famine by a national wide failure of crops. Therefore, it is to the men of genius who invent and to the men of capital and enterprise who manufacture and produce that the great share of credit is due for the upbuilding of the American nation and its supremacy in the world of industry and commerce.

*Address: Masonic Building, Louisville, Ky.

* * *

HORSEPOWER REQUIRED TO COMPRESS AIR*†

By J. WILLIAM JONES‡

In estimating the various items in compressed air computations, it is customary to employ formulas previously determined, and generally published in various hand-books. This custom not only eliminates the possibility of errors, but saves time that would otherwise be used in long calculations. For the same reason the tables in the accompanying Data Sheet Supplement will be found invaluable to those who have to deal with calculations relative to compressed air.

When air is compressed in a cylinder without the removal of any heat due to compression, the compression is termed "adiabatic." On the other hand, when the heat of compression is removed as fast as produced, the compression is known as "isothermal." Neither of the above conditions are ever met with in actual practice. The actual compression curve, however, follows the adiabatic curve closely, and we, therefore, assume that the compression is adiabatic, as any slight difference is on the safe side. Isothermal compression is an impossible ideal, and the horsepower, mean effective pressure, etc., relating to isothermal compression are employed in the making of comparisons only.

The formula for calculating the horsepower required to compress, adiabatically, a given volume of free air to a given pressure is as follows:

$$\text{H.P.} = \frac{144\,NPVn}{33000\,(n-1)}\left[\left(\frac{P_3}{P}\right)^{\frac{n-1}{Nn}} - 1\right]$$

in which

N = number of stages in which compression is accomplished,

P = atmospheric pressure in pounds per square inch,

P_3 = absolute terminal pressure in pounds per square inch = gage pressure plus atmospheric pressure.

V = volume of air in cubic feet, to be compressed per minute, at atmospheric pressure,

* With Data Sheet Supplement.

† For further information on kindred subjects, see MACHINERY, November, 1909, "Compressor Designing—The Distribution of the Load"; March, 1910, "Air Compressor Testing"; August, 1910, "High-pressure Cylinder Diameters for Air Compressors." See also MACHINERY's Data Sheet for August, 1910, "High-pressure Cylinder Diameters for Air Compressors."

‡ Address: Painted Post, N. Y.

n = exponent of the compression curve, taken as 1.41 for adiabatic compression.

Simplifying the above formula for the different stages and for a value of one cubic foot we have:

For one-stage compression:

$$\text{H.P.} = 0.015\ P\ (R^{0.29} - 1)$$

For two-stage compression:

$$\text{H.P.} = 0.030\ P\ (R^{0.145} - 1)$$

For three-stage compression:

$$\text{H.P.} = 0.045\ P\ (R^{0.097} - 1)$$

For four-stage compression:

$$\text{H.P.} = 0.060\ P\ (R^{0.0725} - 1)$$

In these formulas $R = \dfrac{P_3}{P}$ = number of atmospheres to be compressed.

For computing the horsepower required to compress, isothermally, a given volume of free air to a given pressure, the following formula should be employed:

$$\text{H.P.} = \frac{144 \times PV}{33000}\left(1 + \text{Nap. log.}\ \frac{P_3}{P}\right)$$

The Napierian logarithm is obtained by multiplying the common logarithm by the factor 2.302585. (Tables are given in Kent's Mechanical Engineer's Pocketbook, 7th edition, page 156.)

In the fourth and fifth columns of the Data Sheets for two- and three-stage compression, it will be noticed that these columns cover the correct ratio of the cylinders, and the intercooler pressure, respectively. The correct ratio of cylinders (r) is obtained by the following formula:

For two-stage compression:

$$r = \sqrt{\frac{P_3}{P}}$$

For three-stage compression:

$$r = \sqrt[3]{\frac{P_3}{P}}$$

Thus, for two-stage compression we extract the square root of the number of atmospheres to be compressed, and for three-stage we extract the cube root. This proportion of cylinder volumes divides the work equally between the different stages, providing the intercooler abstracts all the heat due to compression in the preceding stage. The intercooler gage pressures, as shown in the fifth column, are obtained by multiplying the absolute intake pressure by the ratio of the cylinder volumes, and subtracting from this result the atmospheric pressure. It should be remembered that the intake pressure of the second-stage cylinder of any three-stage machine is the absolute intercooler pressure from the cooler between the first and second stages.

Let

P_1 = intercooler pressure between first and second stages,

P_2 = intercooler pressure between second and third stages.

Then, for two-stage compression:

$$P_1 = \left(P \times \sqrt{\frac{P_3}{P}}\right) - P$$

For three-stage compression:

$$P_1 = \left(P \times \sqrt[3]{\frac{P_3}{P}}\right) - P$$

$$P_2 = \left(P_1 \times \sqrt[3]{\frac{P_3}{P}}\right) - P$$

It is sometimes advantageous to know the mean effective pressure per stroke as shown on the Data Sheets. By dividing 144 by 33,000 we obtain a factor 0.00436, which divided into the horsepower will give the mean effective pressure per stroke.

* * *

It requires very little ability to find fault. That is why there are so many critics.—*Oliver Wendell Holmes.*

INCREASING THE PRODUCT OF AUTOMATIC SCREW MACHINES

By S. N. BACON

In the following the writer will describe two pieces on which the production was increased fifty per cent. The first piece contains, as the reader will notice, some valuable information in regard to the forming of work to a small diameter. By referring to screw machine treatises, tables, etc., it will be found that two-and-one half times the smallest diameter of the work is the maximum width advised for forming; that is, the width of the form tool cutter a for forming the screw at A in Fig. 1 should not exceed two-and-one-half times the diameter of the threaded body b. This means that when we have a piece too long to form, it must either be reduced by a hollow-mill or a box-tool. As this subject has not been thoroughly

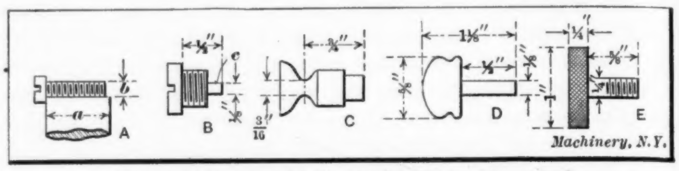


Fig. 1. Work on which the Production was increased

explained, that is, the relation of the width of the form tool to the diameter of the stock, the writer will give a few results of experiments which he has made.

First, by actual test it has been found that screws and other parts made from machine and tool steel can be formed with a form tool whose width is four times the smallest diameter of the part to be formed. Now this does not mean a piece as shown at B in Fig. 1, where the smallest diameter c is on the end of the piece, but it applies to pieces similar to those shown at A, C and D, where the smallest diameter of the work is next to the spindle. Again, it would be very easy to form with a tool of a width equal to four times the smallest diameter, if that diameter were not very small. Two examples of this class of forming are given, and the reader can safely use them as a guide for doing work of a similar character.

The first test was the forming of a 5/8-inch piece of screw stock with a tool 7/16 inch wide, down to 7/64 inch diameter.

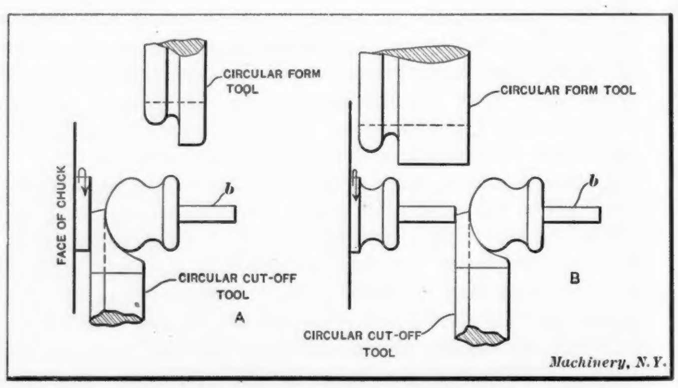


Fig. 2. Method of applying the Circular Form and Cut-off Tools to increase the Product

Here we have a width of four times the smallest diameter. It might also be mentioned that this test was performed on a No. 2 Brown & Sharpe automatic screw machine and that the surface speed of the stock averaged about from 80 to 85 feet per minute, with a feed of 0.001 inch per revolution. This forming was successfully done without any of the pieces breaking off.

The second test was made on a piece of 3/8-inch iron wire, which was formed to a diameter of 3/16 inch, the form tool in this case being 1 inch wide. This test was made on a 3/8-inch Cleveland automatic screw machine. The maximum surface speed of the stock was 90 feet per minute and it was calculated as nearly as possible that the chip averaged from 0.0004 to 0.0008 incn thick.

The writer believes that this information will help those who are designing cams, as the slow and troublesome method of using a hollow-mill and box-tool can sometimes be avoided when the designer knows that he can form a piece with the

circular form and cut-off tools. The two methods of forming the piece shown at A and B in Fig. 2 on the No. 2 B. & S. automatic screw machine, and the following order of operations show clearly the advantage that the forming method has over the box-tool or hollow-mill method of turning.

In the method shown at A, two roughing box-tools are used for reducing the diameter of the stem b, and as the stem was also required to be smooth, a finishing box-tool was used, as can be seen in the following order of operations. The feed also had to be fine, to avoid a large teat, as the cut-off tool forming such a round head would cause the piece to break off before it had been entirely cut off.

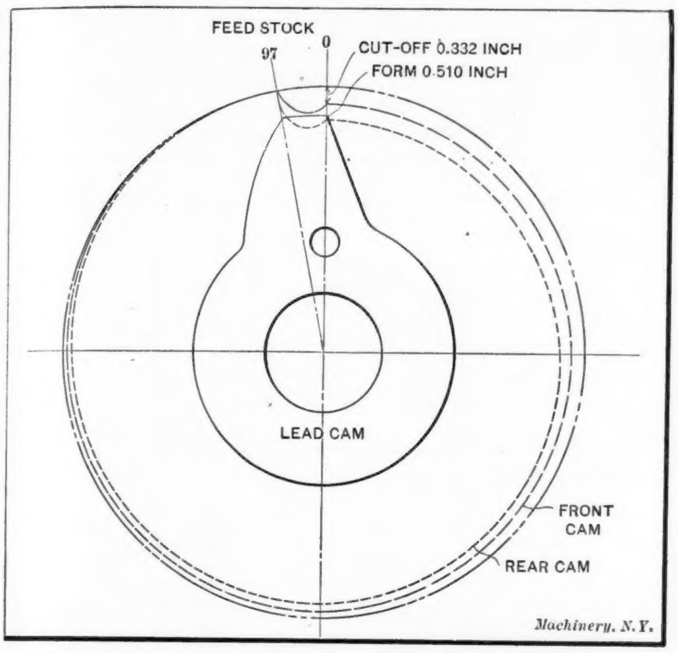


Fig. 3. Cams for Making the Piece shown in Fig. 2 by the Method shown at B

Order of Operations	Revolutions	Hundredths
Feed stock to stop,	29	2½
Revolve turret,	29	2½
First roughing box-tool 0.500-inch rise at 0.005-inch feed,	100	8½
Revolve turret,	29	2½
Second roughing box-tool 0.500-inch rise at 0.005-inch feed,	100	8½
Revolve turret,	29	2½
Finishing box-tool 0.500-inch rise at 0.005-inch feed,	100	8½
Revolve turret,	29	2½
Form, 0.510-inch rise at 0.0015-inch feed,	340	29
Cut-off, 0.332-inch rise at 0.0009-inch feed,	383	33
Revolve turret twice while cutting off,	(58)	(5)
Total number of revolutions to make one piece,	1168	100

The spindle speed used was 549 R.P.M., so that the time to make one piece was 135 seconds, gross product in 10 hours, 266 pieces.

The new method of making this piece is shown at B in Fig. 2. Here the form tool travels the same distance as in the method shown at A, but a much finer feed is used on account of the greater width of form. No time is lost by this, however, as one piece is being cut off at the same time that another piece is being formed. It might be well to mention, however, that no trouble was experienced by feeding the stem out against the stop, that is, the stem b did not bend or become distorted in any way.

By comparing the following order of operations with those previously given, it will be noticed that there is considerable increase in production, and also that the work is handled more expeditiously, and a good job is the result.

Order of Operations	Revolutions	Hundredths
Feed stock to stop,	16	3
Cut-off, 0.332-inch rise at 0.0007-inch feed,	503	97
Form, 0.510-inch rise at 0.001-inch feed,	(503)	(97)
Revolve turret five times,	(80)	(15)
Total number of revolutions to make one piece,	519	100

The speed of the spindle was 519 R.P.M., giving a maximum surface speed of 84 feet per minute. The time required to make one piece was 60 seconds, giving a gross product of 600 pieces in 10 hours. This is a considerable increase over 266 pieces, which were obtained by the method shown at A, and the gain is not made by "hogging" out the work, because the feeds are finer and the work is better.

The cams used for the operation shown at B in Fig. 2 are shown in Fig. 3. Here it can be seen that the cut-off and form cams start at 0 hundredths and finish at 97 hundredths on the cam circle. The form cam is shown by the dotted lines and the cut-off by long dashes; and the lead cam by a full line.

Another piece on which the production was increased considerably is shown at E in Fig. 1. This is a thumb-screw made from 1-inch machine steel on a ⅞-inch Cleveland automatic screw machine, which had been changed to take 1-inch stock. This piece was first made on an old-style Cleveland automatic screw machine having a single-acting cross-slide, that is, the front and back tools were mounted on the same slide and could not be operated independently. The order of operations for making this screw by this method is as follows:

Order of Operations	Revolutions	Seconds
Feed stock to stop,	30	6
Form,	275	55
Knurl from turret,	100	20
Thread on and off,	40	8
Cut-off,	300	60
Total number of revolutions to make one piece	745	149

This order of operations gave a gross product of 240 pieces in 10 hours.

To increase the production of this piece it was transferred to a new Cleveland machine which had a double independent cross-slide, thus enabling the cut-off and form tool to be operated at the same time. A cross-slide knurling tool was also used on the cross-slide, obviating the necessity of putting it in the turret. The order of operations for this piece is as follows, and it can be seen that a considerable increase was the result of this change.

Order of Operations	Revolutions	Seconds
Feed stock to stop,	30	6
Cut-off,	300	60
Knurl, attached to cut-off tool,	....	....
Form, while cutting off,	(275)	(55)
Thread, on and off,	40	8
Total number of revolutions to make one piece	370	74

The gross product by this method was 486 pieces in 10 hours, or twice that of the previous method.

* * *

SOFT SOLDERING FLUX

By C. D. K.

In soft soldering or tinning metals, it is necessary to have the surfaces operated upon free from the metallic oxides that are usually found on them. They should be quite bright or at least chemically clean for this purpose, and they are usually scraped or polished. When they have been treated in this way it is found that it is best to apply some sort of flux, which helps the soldering in several ways, and when they are united the adhesion is much better. The bright metal is much more apt to take up fresh oxygen, especially when it is heated in the oxidizing portion of a gas or Bunsen flame, but the flux when applied, helps to protect it from fresh oxidation, and some fluxes help to remove oxidation, also. Common resin, sal ammoniac, muriatic or hydrochloric acid and chloride of zinc are used for fluxes as well as others, but the first four are generally used. Zinc chloride, or as it is sometimes called muriate of zinc, has many advantages for use in some of the soldering work which machinists and toolmakers have to do, such as soldering pieces of steel, iron, brass and copper, especially iron and steel. The remarks given herewith do not pretend to deal with the methods used in places where large numbers of pieces and large pieces are tinned, but those adapted for the smaller operations in this line of work.

The most convenient form for using the zinc chloride as a flux for such work, is in that of a solution of zinc chloride (Zn Cl²) in alcohol, to which a little glycerine is added, which makes it sticky and causes it to adhere more readily to the articles to be soldered. Zinc chloride can be obtained in two forms, one of which is the salt sold by wholesale druggists and chemists, and which comes in bottles in anhydrous crystals and readily dissolves in water and in alcohol, with a caustic solution. The salt is deliquescent, taking up moisture, and should therefore be k pt covered up when not in use.

The other form can be prepared by dissolving metallic zinc in hydrochloric or muriatic acid. This form is apt to be corrosive as it frequently contains free acid, and the salt is therefore preferable. It is obtained by a similar process, but the acid has all been evaporated. The form made direct from acid can be used, however, without any other solvent; but the other form requires a solvent of some sort so that it can be applied to the work. Alcohol possesses two advantages which adapt it to this purpose, as it dissolves the chloride readily and when applied to the work takes fire if the work is hot enough, thus acting as a temperature indicator and helping to heat the work and keep it hot while the soldering is being done. Various proportions are given for mixing the chloride, alcohol and glycerine, but as alcohol will dissolve the chloride in various proportions these can be varied to suit individual preferences.

One formula gives the proportions as follows:

Zinc chloride	5 parts
Alcohol	4 parts
Glycerine	1 part

Another formula used successfully is as follows:

Zinc chloride	2 parts
Glycerine	3 parts
Alcohol	5 parts

These mixtures can be kept for a long time in ordinary bottles with corks, but it is preferable to use glass stoppers when they can be obtained. A brush, cloth or swab is convenient for applying the solution to the work, but whatever is used should be kept away from the flame on account of the alcohol in the mixture.

Cast-iron pieces can be successfully tinned and soldered with a flux of zinc chloride solution, but great care is necessary in all the work and the cleaning, fluxing, heating, and soldering must be well and carefully done.

Another "wrinkle" of soldering can be done by the aid of a flux, where the surfaces of the work fit together well, and this is soldering together by means of a piece of tinfoil. The surfaces must be cleaned thoroughly and closely fitted, and then bound together firmly with wire or held by clamps. The work is then heated by a lamp or a Bunsen burner or in a fire, using plenty of flux as needed, until the foil melts and joins the surfaces of the work together. Care, of course, must be taken to cool it properly and not disturb the parts until the tin has become thoroughly set and crystallized.

* * *

APPLICATION OF BALL BEARINGS TO LATHE CARRIAGE GEAR

By RACQUET

There seems to be no limit of uses to which ball bearings may be put. A few years ago the bicycle was about the only machine to use this type of anti-friction bearing to any great extent, but now it is the exception rather than the rule to find any machine that does not contain at least one ball bearing. About the most novel application that I know of is the one described herewith and I can safely say that the advantages derived were so self-evident that there was no question as to the efficiency of the arrangement. Fig. 1 is an elevation of a lathe apron showing the position of the gears for the longitudinal feed. Fig. 2 shows the method of driving the feeding arrangement from the feed-shaft, situated at the front of the lathe. It will be seen that the worm which is keyed to the feed-shaft drives the worm-wheel at the back of the apron which is keyed to the shaft *A*. The shaft *A* has forged solid with it a friction cone *B*, which engages with a corresponding friction surface in the 30-tooth by 7-pitch gear, which when in a normal position revolves loosely on the shaft. On the outer end of the shaft and keyed to it is another friction *C* which also engages with the 30-tooth by 7-pitch gear, only on the opposite side. This arrangement of double frictions was necessary because of the comparatively heavy pressure to be transmitted.

To engage the automatic feed, the knob *D* is clamped by turning it to the right on the threaded end of the shaft *A*. This, of course, clamps the shaft *A* to the gear, thus compelling the latter to revolve with the shaft. The small nut on the inside of the knob was used to prevent the knob from working off due to vibrations, and dropping on the floor.

When the lathe was erected it was found on trial that no matter how tight the knob *D* was clamped (by hand, of course) the hand-wheel could easily be turned by applying a force of

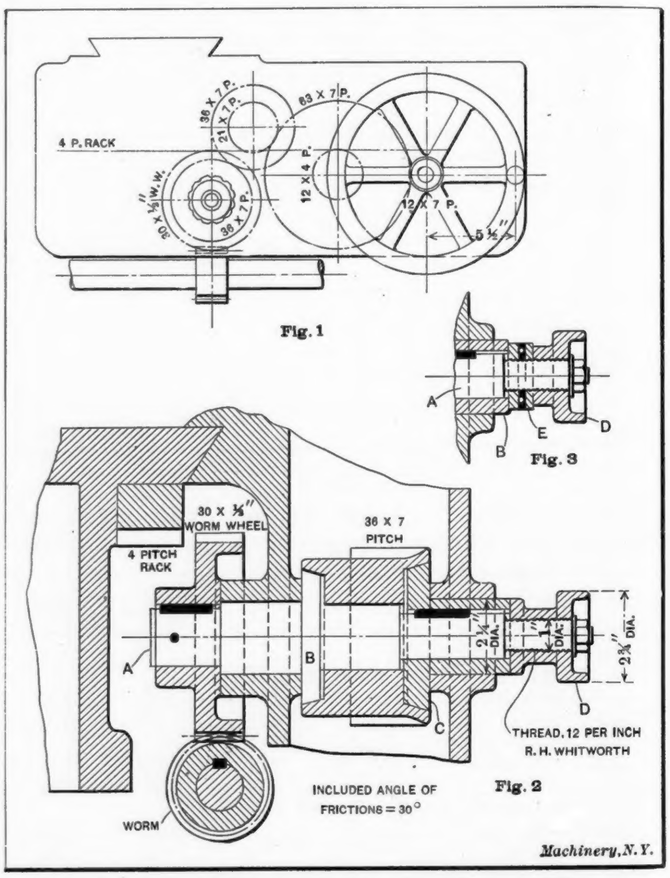


Fig. 1. Elevation of Lathe Apron showing Position of Gears for Longitudinal Feed. Fig. 2. Sectional View showing Feed Arrangement. Fig. 3. How Thrust-bearing was applied

between 40 and 50 pounds, this being equivalent to about 900 pounds cutting pressure, whereas it should have been at least twice that amount. After carefully considering the matter, I came to the conclusion that the friction between the knob *D* and the friction cone *C* was where the trouble lay, owing to the fact that the diameters of the surfaces in contact were too large in comparison to the diameter of the knob. One way of minimizing the trouble would be to reduce the diameters of the surfaces as much as possible, but this was not thought to b a good idea. I then decided to introduce ball bearings, and fortunately, as we carried several sizes of thrust-bearings in stock, it was not difficult for me to secure the size suitable for this, so it was only the question of a few minutes before I had one in position and found that it worked perfectly. By clamping the knob with only one hand it was found that a pressure of 150 pounds could be applied on the hand-wheel without the friction slipping. It will therefore be seen that by this simple expedient, the power of the friction was at least trebled, and in addition the knob was much easier to engage and disengage. Fig. 3 shows how the thrust-bearing *E* was applied, the only difference being that a shorter knob *D* was used. I might say that this lathe took a cut 3/4 inch deep, and 0.033 inch feed per revolution on a fairly tough steel bar, and we had no trouble with the friction slipping.

A PROBLEM IN DISK FRICTION*

THE POSSIBILITY OF A NEW THEORY FOR ARRIVING AT THE IDEAL COMPROMISE OR HAPPY MEAN VALUE IN MACHINE DESIGN

By JOHN S. MYERS†

In the designing of machinery it is impossible to have everything ideal; on the contrary, the designer is continually compromising between the desirable and the undesirable, and the design will be good, bad, or indifferent in proportion to the care and judgment exercised when making these compromises. Now, if it were possible to develop a theory of the compromise between those things which are desirable and those which are not, applying mathematics as a means whereby results might be obtained with some precision and logic, instead of being guessed at, hit or miss, as now seems to be the prevailing fashion, it should be of great value to the designer. In

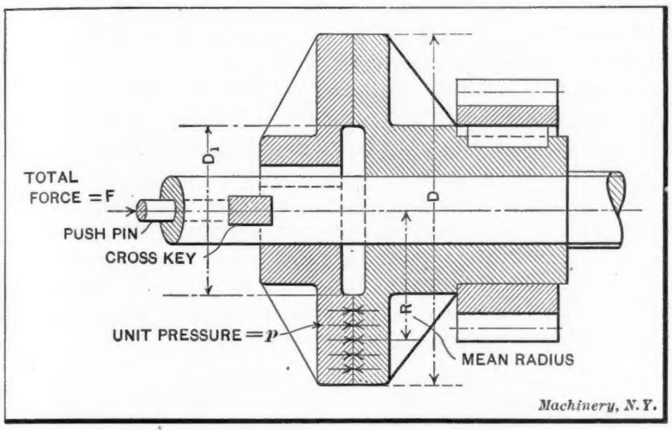


Fig. 1. Section of Disk Clutch

the present article is presented a problem in connection with a disk friction clutch which suggests the development of such a theory. The writer presents, first, his conception of the general problem in the hope that it may start others thinking along this line, with the purpose of eventually securing a scientific method of dealing with desirable and undesirable conditions, and second, a tentative solution to a specific problem in relation to disk friction.

Proposed Problem of finding the Happy Mean or Ideal Compromise in Machine Design

In the case of three variables, let y and z be functions of x, either explicit or implicit. Let x be the independent variable, *i. e.*, the one which may have any value at the will of the designer. Then y and z are two dependent variables.

Now, in most mechanical problems, there are certain states of the dependent variables (y and z) which are desirable states. What these desirable states are depends upon the nature of the specific problem under consideration; for instance, it may be desirable either to have both y and z a minimum, a maximum, or to have one a minimum and the other a maximum; but the desirable states of y and z may be determined by some consideration entirely extraneous to the direct mathematical relation existing between x, y and z.

Generally speaking, it is the exception rath r than the rule that the desirable states of y and z are contemporaneous, *i. e.*, that they occur at the same value of x, and, if such be not the case, it is then impossible to have both y and z at their desirable states. This is the condition that has given birth to the oft-used expression, strike a "happy mean", which conveys the idea of approaching as nearly to the desirable states as their mutual interdependence permits. Again, viewed in the light of the impossiblity of having both quantities at their desirable states simultaneously, we may consider the process as one of choosing between necessary evils, in which case the term "ideal compromise" is appropriate and conveys the idea of departing from the desirable states as little as possible.

Assume that y and z are explicit functions of x and let the subscript ($_d$) denote the desirable state of the function to which it is appended;

Then $y = f(x)$,

$z = \phi(x)$,

y_d = desirable state of the function y,

z_d = desirable state of the function z, and

x_h = happy medium value of x, which is to be determined.

Now let C denote, in general, a coefficient of relative importance for the dependent variables and, by the addition of a subscript,

Let C_y = coefficient of importance of y, and

C_z = coefficient of importance of z.

If C_y or C_z be used as a multiplier of y_d or z_d they may be considered as *coefficients of desirability*; thus if y be twice as important as z, then $C_y = 2$, and $C_z = 1$ and we would say that it was twice as important to have $y = y_d$ as to have $z = z_d$; but, since in the general solution y and z may represent dissimilar quantities, and since each is dependent upon x by some law or laws whose mathematical expression may be any one of an infinite variety of forms, there is, then, absolutely no general numerical equality between y_d and z_d, and therefore we may not say that $y_d = z_d$, or that $C_y\,y_d = C_z\,z_d$; but there may be some definite mathematical relation between the ratio $y:y_d$ and the ratio $z:z_d$, in which either or both may be affected by a coefficient of desirability, C_y or C_z; hence the problem takes this form:

Construct an equation which shall express such a relation between $z : z_d$, $y : y_d$, C_y and C_z that its solution will give the "happy medium value" of x corresponding to an "ideal compromise" between the two unattainable, desirable states of $y = y_d$, and $z = z_d$.

A Problem in Disk Friction with Tentative Solution to the Ideal Compromise Problem

The specific problem which first suggested to the writer the possibility of a general theory covering the subject of compromise is as follows:

In a disk clutch, the outside diameter D, the coefficient of friction C, and the torque to be transmitted T are given.

(*a*). What should be the proportion of the inside diameter D_1 to the outside diameter D in order that the average unit pressure p may be a minimum?

(*b*). What should the proportion be in order that the total force F pressing the disks together may be a minimum?

(*c*). Can both these desirable states be obtained?

(*d*). If not, what is the ideal compromise or happy mean between these two values of D_1 (See Fig. 1).

The solution of the problem proper involves first a settling of the mooted question as to whether the center of tangential or frictional forces lies at the mean radius of the disk, as claimed by some, or whether it is coincident with the center of gravity of a narrow sector of the disk. This phase of the problem was treated on page 924, July, 1910, issue of MACHINERY, engineering edition, the deductions there drawn being that the center of tangential effort is, at least approximately, at the mean radius of the disk. If R equals this radius we then have:

$$R = \tfrac{1}{4}(D + D_1) \tag{1}$$

Solution for Minimum Value of p

Having the radius R at which the tangential frictional forces act, we may now write an equation for the torque T, as follows:

$$T = FCR \tag{2}$$

But

$$F = p \times \text{area of disks} = \tfrac{1}{4}\pi p (D^2 - D_1^2) \tag{3}$$

Substituting in (2) the values of R and F as given by (1) and (3) we have:

$$T = \frac{1}{4}\pi p (D^2 - D_1^2)\, C \times \frac{1}{4}(D + D_1), \text{ or}$$

$$T = \frac{1}{16}\pi C p (D^3 + D^2 D_1 - D D_1^2 - D_1^3) \tag{4}$$

from which

*See MACHINERY, July, 1910, engineering edition: "Mean Radius of the Frictional Forces of a Disk Brake."

†Address: 2456 Almond St., Philadelphia, Pa.

$$p = \frac{16\,T}{\pi\,C\,(D^3 + D^2 D_1 - D D_1^2 - D_1^3)} \qquad (5)$$

By the methods of calculus it may be shown that p will become a minimum when $D_1 = 1/3\,D$.*

Inserting this value of D_1 in (5) gives:

$$p = \frac{27\,T}{2\,\pi\,C\,D^3} \qquad (6)$$

This is the minimum average unit pressure for any given values of T, C and D.

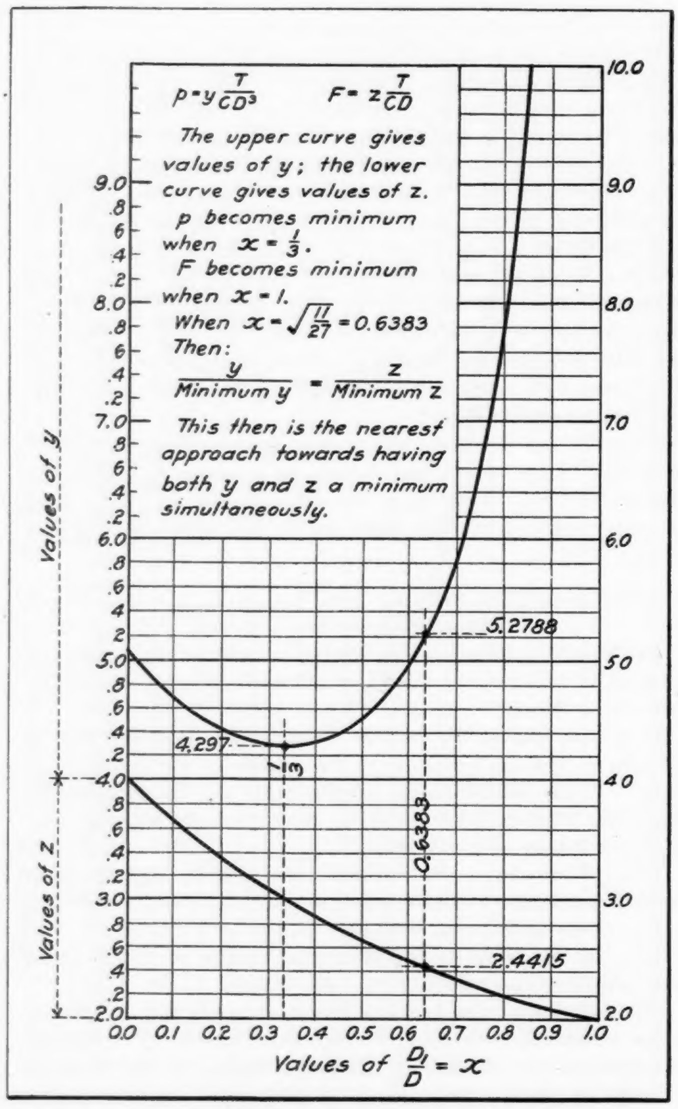


Fig. 2. Diagram showing Relative Values of y and z in Basic Equations for Disk Clutch Problem

Inserting $D_1 = 1/3\,D$ in (4) or solving (6) for T gives:

$$T = \frac{2}{27}\,\pi\,C\,p\,D^3 \qquad (7)$$

This is the torque developed by the clutch for any given values of C, p and D. If the value of p be taken at the maximum safe value, then this equation gives the maximum capacity of the clutch.

The total force pressing the plates together in order to transmit the torque is, in general:

$$F = \frac{4\,T}{(D + D_1)\,C} \qquad (8)$$

For

$$D_1 = \frac{1}{3}D, \quad F = \frac{3\,T}{DC} \qquad (8\,A)$$

Equation (8 A) gives the value of F for the minimum value of p.

The Ideal Compromise

Now, in the usual construction it is not only desirable to have as low a value of p as possible, in order that the wear may be reduced and that the clutch may be able to develop the highest possible torque consistent with the safe bearing capacity of the material and the conditions of lubrication, but it is also desirable to have as low a value of F as is consistent with the low value of p. Now p is minimum at $D_1 = 1/3\,D$, and F is minimum at $D_1 = D$, so that it is impossible to have both a minimum, but somewhere between these limits there is a point at which the increase over the minimum value of p will be the same percentage of that minimum as the increase over the minimum value of F is in per cent of the minimum value of F. Tentatively, we may assume, with a certain amount of justification, that this point is the "happy medium" value of D_1 when it is just as important to have p a minimum as it is to have F a minimum; in other words, this is the "ideal compromise." This condition will exist when

$$\frac{p - \text{Minimum } p}{\text{Minimum } p} = \frac{F - \text{Minimum } F}{\text{Minimum } F}$$

which reduces to

$$\frac{p}{\text{Minimum } p} = \frac{F}{\text{Minimum } F} \qquad (9)$$

The minimum value of p is given by equation (6), and the value of p for any value of D_1 is given by equation (5). The value of F for any value of D_1 is given by (8) and, since the minimum value of F occurs when $D_1 = D$, this minimum value must be:

$$F = \frac{2\,T}{DC} \qquad (10)$$

Substituting these values in (9) gives:

$$\frac{16\,T\,2\,\pi\,C\,D^3}{\pi\,C\,(D^3 + D^2 D_1 - D D_1^2 - D_1^3)\,27\,T} = \frac{4\,T\,D\,C}{(D + D_1)\,C\,2\,T}$$

$$\text{or } D_1 = D\sqrt{\frac{11}{27}} \cong 0.6383\,D \qquad (11)$$

This is the value of D_1 giving the nearest approach to having both p and F at their minimum values. This is then the "ideal compromise" between two desirable conditions which cannot both be obtained, and is a proposed solution to question (d) of the problem.

Relation of Unit Pressure to Total Pressure

To better show the relations of the variables p and F, curves may be plotted.

$$\text{Let } x = \frac{D_1}{D}; \text{ then } D_1 = x\,D \qquad (12)$$

Substituting in equation (5) we have:

$$p = \frac{T}{C\,D^3}\left[\frac{16}{\pi\,(1 + x - x^2 - x^3)}\right] \qquad (13)$$

Now let

$$y = \frac{16}{\pi\,(1 + x - x^2 - x^3)} \qquad (14)$$

Then

$$p = y\,\frac{T}{C\,D^3} \qquad (15)$$

---

*This may be deduced as follows: In equation (5) if π, C and T are constant factors, then p will become a minimum when the quantity within the parentheses in the denominator becomes a maximum. Let y be this quantity, then:

$$y = D^3 + D^2 D_1 - D D_1^2 - D_1^3,$$

which being differentiated with respect to D_1 gives:

$$d\,y = D^2 d\,D_1 - 2\,D\,D_1\,d\,D_1 - 3\,D_1^2\,d\,D_1$$

$$\text{Then } \frac{d\,y}{d\,D_1} = D^2 - 2\,D\,D_1 - 3\,D_1^2$$

Equating this first differential coefficient equal to zero gives:

$$D_1^2 + \tfrac{2}{3}\,D\,D_1 = \tfrac{1}{3}\,D^2$$

Adding $\frac{1}{9}\,D^2$ to complete the square gives:

$$D_1^2 + \tfrac{2}{3}\,D\,D_1 + \tfrac{1}{9}\,D^2 = \tfrac{4}{9}\,D^2$$

Extracting the square root gives:

$$D_1 + \tfrac{1}{3}\,D = \pm\,\tfrac{2}{3}\,D$$

from which

$$D_1 = \tfrac{1}{3}\,D \text{ or } D_1 = -\,D$$

This second expression, being an imaginary value, need not be considered; hence the value $D_1 = \frac{1}{3}\,D$ is the only value to investigate to determine whether it corresponds to a maximum or minimum value of y, and, since a curve is plotted later on in the article, further investigation is unnecessary here.

Substituting in equation (8) the value of D_1, as given in equation (12), we have:

$$F = \frac{T}{CD}\left(\frac{4}{1+x}\right) \qquad (16)$$

Let

$$z = \frac{4}{1+x} \qquad (17)$$

Then

$$F = z\frac{T}{CD} \qquad (18)$$

Calculating values of y and z by formulas (14) and (17) gives the values shown in the accompanying table.

Plotting the values given in the table gives the diagram shown as Fig. 2, on which the minimum values of y and z, as well as the compromise value of x, are plainly indicated.

The foregoing formulas can readily be applied to multiple disk clutches, such as the Weston clutch, by letting

$$T = \frac{\text{total torque}}{\text{number of rubbing surfaces}} \qquad (19)$$

Conclusion

The conclusions to be drawn in relation to the disk problem are that the ratio of inside to outside diameter should be at least one-third, which corresponds to a minimum mean average unit bearing pressure on the disks, and where it is desirable to keep the total force pressing the disks together as low as possible, this ratio should be increased. When $\frac{D_1}{D}$ equals 0.64, approximately, we have the ideal compromise between the two unattainable states of minimum unit pressure and minimum total pressure, based upon the assumption that these two states are equally desirable.

CALCULATED VALUES OF FACTORS y AND z FOR USE IN EQUATIONS (15) AND (18)

$x = \frac{D_1}{D}$	$y = \frac{16}{\pi(1+x-x^2-x^3)}$	$z = \frac{4}{1+x}$	$x = \frac{D_1}{D}$	$y = \frac{16}{\pi(1+x-x^2-x^3)}$	$z = \frac{4}{1+x}$
0 00	5.093	4.000	0.6383	5.279	2.442
0.10	4.677	3.636	0.7000	5.874	2.353
0.20	4.421	3.333	0.8000	7.859	2.222
0.30	4.305	3.077	0.8500	9.924	2.162
$\frac{1}{3}$	4.297	3.000	0.9000	14.108	2.105
0.40	4.331	2.857	0.9500	26.791	2.051
0.50	4.527	2.667	1.0000	∞	2.000
0.60	4 974	2.500	......	......	.....

The conclusion to be drawn in relation to the general subject of compromise between desirable and undesirable values of variables in design is that a rational method or general theory might be developed applicable to any problem capable of formulation. The solution to the specific problem given is not general. It fails as soon as any of the desirables become zero or infinity, and is, therefore, not rational and probably not absolutely theoretically correct, even for the particular case it is here applied to. It is, however, better than pure guesswork, inasmuch as a certain amount of logic is used in justification of the method pursued.*

*To those who may attempt a solution of this interesting problem the writer desires to call attention to some points liable to develop in arriving at a solution:

(a) C_y and C_z are, in a sense, functions of the form of the equation expressing the relation between x, y, and z, *i.e.*, in a certain problem it may seem desirable to give C_y double the value of C_z, but the form of the equation controlling the mutual interdependence of x, y, and z may make this impossible, or give an undesirable value of C.

(b) While, by hypothesis, x is an independent variable which may have any value whatever at the will of the designer, it is obvious that $x = x_h$ is the one value to be desired, but, in attempting to find this value of x, it must be remembered that x may have some desirable value entirely inherent in itself, *i.e.*, by the very nature of the specific quantity which x represents, and entirely independent of its mathematical relation to y and z, there may be some desirable value of x such as $x_d = x$ min. $x_d = x$ max. etc. When x possesses any such inherent characteristics, it would probably be well to have a special case covering it in the general solution.

(c) It would seem that neither of the coefficients of desirability could ever be infinite in relation to the other, as this would mean that the other desirable state was not really a state to be desired, but a state of no importance.

WORM GEARING EMPLOYED FOR FREIGHT ELEVATORS

By A. P. ELTOFT*

The writer was recently called into consultation concerning worm gearing as applied to freight elevators. The inquirers state that they employ a worm gear having 108 teeth, ¾-inch pitch, 2 1/2-inch face, and a worm 5 3/16 inches diameter, single thread, direct connected to an electric motor running 850 R.P.M., and are having some difficulties with regard to the worm's heating and the current taken by the motor being too great. The drum is 24 inches diameter, and the load on the drum is 4000 pounds, which corresponds to 3720 pounds on the worm gear teeth. These manufacturers use a hob the exact diameter of the worm and allow for clearance in erection. This is bad practice, as the two surfaces on gear and worm brought into contact by this method do not correspond to each other and a good contact can not be expected. A hob should be used that cuts the clearance for the worm, thus permitting the worm axis to coincide in position with that of the hob when the wheel was cut.

Another improvement upon this gearing would be to reduce the diameter of the worm, provided this is possible. With the dimensions given, the angle of thread is 2 degrees 39 minutes and the efficiency of the worm gearing for a coefficient of friction = 0.05 would be 0.48 (see MACHINERY, September, 1910, page 43, engineering edition), while if the diameter of the worm be reduced to say 3¾ inches the angle of thread would be increased to 3 degrees 39 minutes and the efficiency to 0.58, or an increase in efficiency of 21 per cent.

It will be seen from the above that a decrease in worm diameter not only reduces the speed of rubbing surfaces, but also increases the efficiency of the machine. In general the worm should be made just as small as the circumstances will allow in order to increase the angle of thread and thereby the efficiency, while maintaining the same pitch and the same number of threads on the worm.

There are three factors which may determine the minimum size of worm that can be used, which are as follows:

First, the diameter of the shaft on which the worm has to be keyed if not made in one piece with this shaft limits the size of the worm. Second, if the gear is to be self-locking the angle of the thread cannot be increased above a certain degree; with the pitch settled on this will determine the diameter of the worm, provided it is single threaded. Third, if the face of the gear is determined, it is not desirable to go below a certain diameter of worm on account of the consequent large face angle.

Concerning the load which can safely be carried on worm gearing, it is determined by one of three considerations, which are: the strength of the material, the danger of abrasion and the danger of overheating.

The first consideration seldom comes into play because a gear proportioned to prevent abrasion and excessive heating will generally have excessive strength. For very slow-running worms and for worms used intermittently with short runs and long intervals, the heating effect does not enter and the determining factor will be danger of abrasion from too high a pressure per unit of contact surface. The contact between worm and worm gear is mathematically a line, but the physical properties of the opposed surfaces and the lubricant between them expand this ideal line into an actual area, and as the radii of curvature increase directly with the pitch, it is natural to consider this surface as directly proportional to the product of pitch and face. The proper allowable load per unit must necessarily be determined by experience, and 1000 pounds to 1200 pounds seems to be about the safe limit of load per $p \times f$ (pitch × face) considering that there ought to be here, as well as in all other designs, a certain margin or factor of safety, as we might say, to prevent having the machine put out of commission by an occasional overload or other accidental excessive pressure. If all the load, as is usual for spur gears, is considered to be taken by one tooth, the stresses pro-

*Address: 6621 Hermitage Ave., Chicago, Ill.

duced in the material for these loads are about the safe stresses for cast iron.

The third consideration, the danger of overheating, is perhaps the most important, and the most trouble with worm gearing is from this source. When more heat is developed than is carried off from the gear housing, the temperature of the oil will increase, but with the higher temperature the oil becomes less viscous and its adhesion to the rubbing surfaces becomes less. The coefficient of friction increases with consequent more rapid increase in temperature. Thus the critical conditions are constantly augmented by one another until the oil film between the surfaces is squeezed out altogether and abrasion occurs. The only safe way to avoid this is, of course, to so design the gearing that the temperature is kept below a certain limit. For continuous service the proper loads may be based on Bach's and Roser's experiments (see MACHINERY, September, 1910). It may be well here to call attention to the fact that the loss of heat from a body is approximately directly proportional to its surface, and consequently a large gear housing is at an advantage. The housing should have stuffing-boxes for the worm shaft, and be well filled with a viscous oil so that the heat created at the point of contact may be distributed quickly to the upper parts of the housing.

For intermittent duty, like that imposed on a freight elevator, the question of allowable load becomes more complicated. The load that can safely be carried on a gear for this class of work will depend entirely on the circumstances, and a value can only be arrived at if these are known, or after certain assumptions as to the maximum time of continuous service, time of intervals, etc. have been made. The total heat developed can then be compared to that for continuous service and a correspondingly higher load allowed, provided, however, that this does not exceed the maximum load allowed without regard to heating.

Consider, for instance, a worm for driving a freight elevator with a load on 24-inch drum of 4000 pounds, worm direct on motor shaft running 850 R.P.M. If in this instance it is considered safe to assume that the maximum average load for a certain unit of time will never exceed 2000 pounds and the time required for loading and unloading the elevator is at least equal to the time of actual running, then the work performed by the worm gearing will be one-fourth of that for continuous service with full load, assuming the coefficient of friction the same for all loads. The heat developed will also be one-fourth of that developed with full load. A gearing designed for continuous service with 1000 pounds load on drum will therefore meet the requirements. For a worm of 3¾ inches diameter running at 850 R.P.M. we have a velocity of 824 feet per minute. For this velocity, a load per unit of pitch times face of 180 pounds is allowable for a difference in temperature of 50 degrees F. (see MACHINERY, September, 1910). The gear will have to have 108 teeth to give the necessary reduction to 50 feet per minute elevating. As this number of teeth is exceptionally large, we can expect a good contact with less danger of abrasion, and a higher temperature difference, say 70 degrees, is warranted. The allowable load is approximately proportional to the temperature difference, and we can, therefore, allow $180 \times 70/50 = 252$ pounds per unit of pitch times face. On account of large diameter of worm gear, the worm and its housings will be comparatively long with consequent large radiating surface, and a temperature difference of 70 degrees will probably not be reached at all.

A worm 4 inches diameter, 1 inch pitch, with gear 34.4 inches diameter, 2¾ inch face, will then carry $252 \times 1 \times 2\frac{3}{4} = 693$ pounds, which corresponds to a load on drum $= 693 \times \frac{34.4}{24} = 993$ pounds, or practically 1000 pounds. The intermittent load on gears will be $4000 \times \frac{24}{34.4} = 2791$ pounds, or 1015 pounds per $(p \times f)$, which in this case is within the limit.

In the case referred to in the first part of this article the load on gear teeth was 3720 pounds for a ¾-inch pitch, 2½-inch face gear, which corresponds to load per unit of $p \times f$ equal to 1984 pounds. This is undoubtedly too heavy a load even for intermittent service, and a gearing with any such load running at high speed is likely to give trouble.

Upon being advised that the gears were too small for the service required of them, the manufacturers object, saying that they are building elevators in competition with other concerns and a material increase in these gears would put them out of business, and state that they have sometimes operated a load of 6000 pounds with a 10 H.P. motor very easily, but on one or two cases with conditions practically the same they have found it very difficult to start the elevator at all except by using a heavy current. Now 6000 pounds at 50 feet per minute represents $\frac{6000 \times 50}{33,000} = 9.1$ H.P. The efficiency of a worm gear with an angle of thread 2 degrees, 40 minutes was found above to be 0.48 for a coefficient of friction of 0.05. This is the efficiency of the worm gearing itself and does not allow for friction in gear or worm-shaft bearings, for end-thrust bearing, for bending of cables or friction in guides. When all this is taken into consideration the horsepower required for running conditions will be at least 22. The horsepower for starting will be still higher and a corresponding electric current consumption in the motor must necessarily result, which indeed must be called high for a 10 H.P. motor.

If defective designs like these are found necessary to obtain business in competition with others, it is certainly a deplorable state of affairs. Customers should be educated to demand machines designed for a reasonably long life and not working under stresses perilously near the point of breakdown.

* * *

SINGLE-PHASE ELECTRIC TRACTION IN FRANCE

The electrification of existing steam railways is being pursued with activity in France. One of the latest electrifications is that which the Midi Railway of France will make in connection with the Montrejeau-Pau portion of the Toulouse-Bayonne Line. The portion to be electrified has a length of some 70 miles; the country is very hilly and the line has a number of steep gradients, one of 3½ per cent being about seven miles in length. This is the largest scale upon which electrification of existing lines has been attempted in France, and the results will be watched throughout Europe with no little interest. Later the electrification is to be extended to the entire Toulouse-Bayonne Line, a distance of 200 miles.

The Midi Railway Co. has ordered from the French Westinghouse Co., the works of which are at Havre, the equipments for thirty double bogie electric motor coaches for the passenger service and one complete electric locomotive for the freight service of this line. The locomotive and motor car equipments will be built by the Italian Westinghouse Co. at the Havre Works, while the mechanical parts of the locomotive will be built by the Italian Westinghouse Works. The design and construction is based on the results obtained in connection with the successful electrification by the Italian Westinghouse Co. of the Giovi tunnel section of the Italian State Railways on the dense traffic line between Genoa and Milan.

Each of the thirty motor coaches (seating about 50 passengers each) will be equipped with four 125-H.P. Westinghouse single-phase motors, 16 2/3 cycles, 285-volts, and with Westinghouse multiple control. These motor coaches will be able to haul trains weighing 100 metric tons—including the motor itself—at a speed of 45 miles per hour on level track. The weight of a motor coach in running order will be about 56 metric tons.

The Midi locomotives will be provided with five axles, three of which will be driven by the motors through jack shafts and connecting-rods. The locomotive will be equipped with two 600-H.P. single-phase motors. The locomotive will weigh 80 metric tons and will be able to haul trains weighing 400 metric tons, inclusive of the locomotive. With a haulage of 280 metric tons the speed will be 25 miles per hour, and with 100 metric tons about 38 miles per hour. The current will be supplied to the motors by means of a 12,000-volt overhead catenary line. The pantagraph type of trolley will be used.

DRAWING-ROOM EQUIPMENT AND ARRANGEMENT

By F. B HAYS* and B. B. COOLEY†

The accompanying illustrations, Figs. 1 and 2, show the equipment and arrangement of a thoroughly modern drawing-room. The main room is made large in order that there will be sufficient space for the equipment without the danger of overcrowding. At the same time the room should be well heated and ventilated, and should face the north in order to secure the steadier light which is always obtained from that direction. It is a well-known fact that the light secured from this direction does not cast the conflicting shadows due to the different positions of the sun during the day, that the light obtained from any of the other three directions does. The whole north wall of the building should be given up to window space, so that plenty of light can be obtained. It is always desirable for right-handed persons to have the light coming from the left, and with this fact in view it is well to arrange the drawing tables so that when the draftsman is at work he faces the east.

At the east end of the main room will be found files and cases running the full width of the room, in which drawings, tracings, pencil sketches and supplies are kept. The files are arranged on each side of the supply cases and extend toward the center for about two-fifths of the width of the room. The supply cases are arranged between the files and are about half their size. The file cases consist of seven sets of files, as shown in Fig. 2, at *b*, *c*, *d*, *e*, *f*, *g* and *h*, respectively. A card index, *a*, which is very valuable to a drafting-room, is arranged at the top of the case. The file *b* is reserved for blueprints of parts, and assemblies of standard products of the plant, file *c* is for tracings, file *d* for original drawings, file *e* for duplicate sketches, and file *f* is for foreign blueprints, that is, blueprints which have been obtained from other companies. The file *g* is for obsolete drawings and prints that are retained for reference. There are eight rows of these files and the drawings of the different years are placed in separate rows, thus making them easily accessible and easy to find.

The supply case *D* consists of two sets of drawers in which supplies, such as tracing cloth, paper, ink, pencils, erasers, etc., are stored. The top of the supply case is constructed of such a height that it also answers the purpose of a table, which will be found very convenient when consulting any of the drawings or prints in the files. On the south side of the room is found another set of files similar to the one just described.

The sample cases *E*, in Fig. 1, are arranged at the west end of the room. These cases consist of several drawers and two or three small cabinets, and are intended as a place to store defective castings, patterns, new parts, etc., which are used for reference by the draftsmen from time to time.

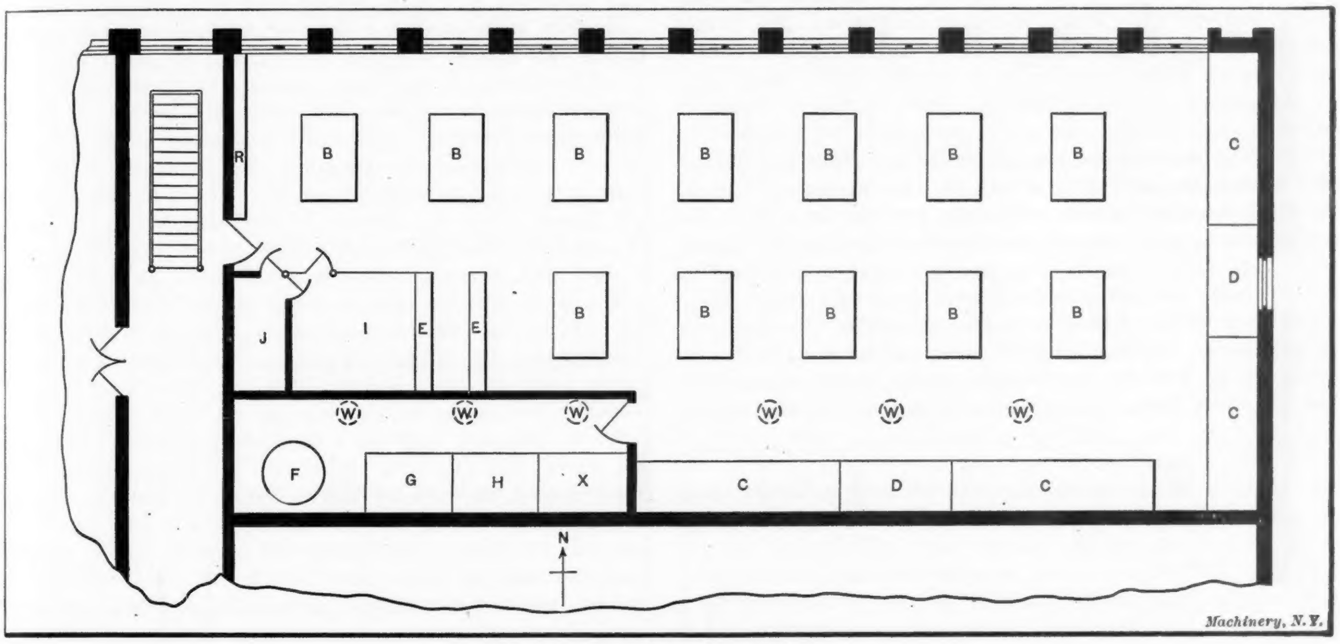


Fig. 1. Plan of a Modern Drawing-room

One of the principal features of the modern drawing-room is the portion set apart for the blueprinting work. This room should be of light-proof construction and should be equipped with all of the modern improvements which have been invented for the process of blueprinting, such as blueprinting machines, steam driers, washing pans, etc. In Fig. 1, the location of the blueprinting machine is at *F*, the steam drier at *G* and the washing pans at *H*.

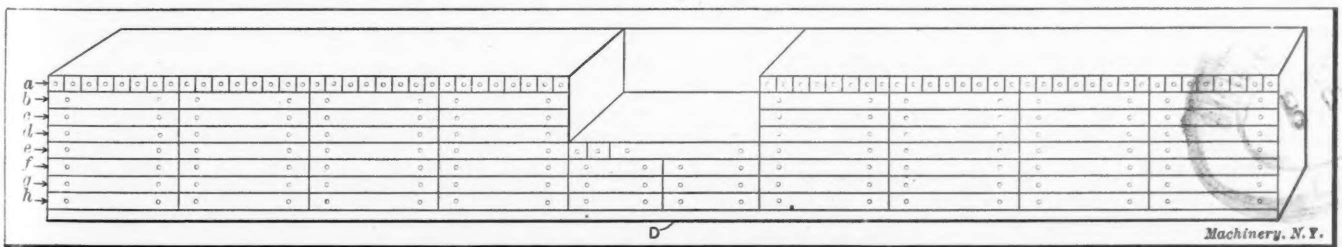


Fig. 2. Arrangement of Files and Supply Cases

The chief draftsman's or engineer's private office is located directly in front of the blueprint room. It is advisable for the head of the department to have a room separated from the drawing-room, where he can discuss his business problems with his employes in private. All of these rooms should be large and well ventilated. A lavatory *J* is located in the west end of the main room next to the engineer's office, but partitioned off from it. The roof should be equipped with a number of ventilators *W*, in order that a good circulation of air can be obtained. The use of skylights has been dispensed with on account of the fact that in a drawing-room equipped with them the draftsman is naturally standing in his own light, and a great deal of his work has to be done in the shadow, which is not only hard on the draftsman's eyes, but detrimental to the work, as no draftsman can do first-class work without proper light.

The illustrations shown here are a combination of the lay-

*Address: Cole Motor Car Co., Indianapolis, Ind.
†Address: Cole Motor Car Co., Indianapolis, Ind.

out and equipment of several of the drafting-rooms in use at the present time in several of the most modern plants in this country.

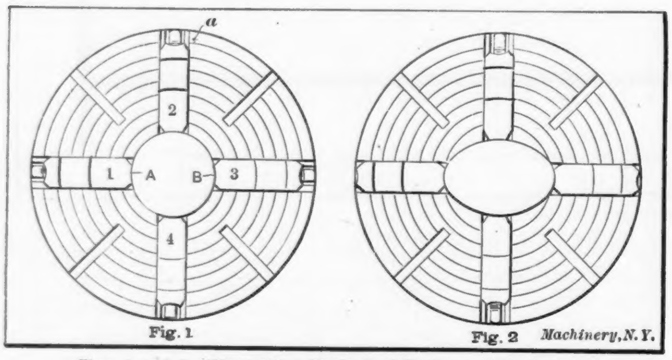
* * *

TRUING UP WORK IN THE LATHE

By CHARLES DOESCHER*

Truing up work in the lathe, when using a chuck or faceplate, is of such frequent occurrence that very little is said with reference to it in the various mechanical papers; in fact it is an operation that is looked upon as being so simple that very little attention is paid to it; however, the method employed by the average mechanic for truing up work can be simplified, therefore making it possible to do this work more easily and quickly. From personal observation, the writer has come to the conclusion that the so-called "chalk method" of truing up work in the lathe is the one most widely used by the general run of mechanics. This method is about as follows:

We will assume that a piece of round bar stock four inches in diameter, and three inches long is to be trued up in a four-jawed independent chuck. After the piece is secured in the chuck, one jaw is loosened, and another tightened until the work runs fairly true to the eye. A tool is then placed in the toolpost and set about parallel with the work, after which the belt is shifted to enable the lathe to run at its fastest speed. A piece of chalk, held in the hand and supported by the tool, is next brought to bear lightly against the fast revolving work. After the lathe is stopped, the jaws of the chuck are adjusted according to the story that the chalk mark tells. The lathe is then started again and the marking operation repeated until the piece runs true; oftentimes it happens that before the work runs sufficiently true, the operator has to take a piece of waste and wipe out the old chalk marks, which are so numerous as to be confusing.



Figs. 1 and 2. Illustrating Method of Truing up Work in an Independent Chuck

A more efficient method of truing up the piece in question is as follows:

Place the work in the chuck and bring the jaws to bear upon it in such a manner that the ends of the jaws will be an equal distance from one of the circular grooves *a*, as shown in Fig. 1. (These grooves are provided on the faces of chucks, in order to facilitate the operation of truing up work.) An off-set tool—preferably a round-nose—is now placed in the toolpost and set to the height of the centers. The point of the tool is brought to bear lightly against the work near jaw number 1, and at a point *A* which is directly central with the jaw itself. The lathe carriage is next moved just enough away from the chuck so that the tool will not come in contact with the work; the lathe spindle is then given one-half a turn by hand, so that the side *B* opposite jaw number 3 will be at an even height with the tool. The lathe carriage is next moved forward until the tool is again opposite the work. If the tool bears hard against the work, jaw number 1 is loosened and jaw number 3 is tightened; on the other hand if there is an open space between the tool and the work, number 3 is loosened and number 1 is tightened. This operation is repeated until the tool bears equally at *A* and *B*. Jaws 1 and 3 should not be tightened too much, in order to allow for truing up between jaws 2 and 4 after the manner described in the foregoing. When the work is true, all four jaws are tightened evenly and the piece will be found to run as true as it is possible to make rough stock run. The advantage of this method is that every move counts; there is no unnecessary running of the lathe at full speed, nor is there any time lost while waiting for it to stop. One can see at a glance where the work is out, and just how much it is out, so that adjustments can be made accordingly.

This same method can be applied when truing up a piece of octagon stock in a four-jawed independent chuck, or an odd-shaped forging, such as is shown in Fig. 2. When using a three-jawed independent chuck, the same method can be applied by adjusting all three jaws so that the tool bears equally upon the work at a point central with each jaw.

It often happens that a piece of work is of such a shape that it can best be strapped on the faceplate when the latter is off the lathe. If the piece is square in shape and is to be drilled outside, it pays to set it before "tightening up" so that the distance from the outside of the faceplate to the center of all four sides measures the same. For example, if the faceplate is 18 inches in diameter and the work is 12 inches square, the distance from the outside of the faceplate to the center of each of the four sides should be 3 inches. By setting work in this way, a great deal of time is saved on a number of pieces, as it does not require nearly as much adjusting to get the part in the required position, as when it is strapped on the faceplate by "guess." Similarly, in truing up a center-punch mark, it pays to see that it is set central with the faceplate, by measuring, before swinging the work in the lathe.

When strapping work on a faceplate which is on the spindle, do not jam the back center into a center-punch mark in order to hold the work while it is being strapped on, but place a collet or nut blank between the work and the center. In this way the point of the center will be kept in good working condition, and the center-punch mark will not become burred or torn, which would make it practically useless as far as accurate truing of the work is concerned.

After the work is strapped in place, time can often be saved, before using a center test indicator, by bringing the point of the back center as near to the work as possible without touching it, and tapping the work so that the center-punch mark runs approximately true. In tightening up the straps, preparatory to "truing up" with an indicator, do not clamp them too tightly, nor screw one bolt tighter than another, as a piece of work that is fastened too tightly cannot be readily adjusted, and there is also a chance of springing the faceplate. When one bolt is tighter than another, one is often fooled, when using an indicator, as it is almost impossible to get the work in a true position; it shifts back and forth to its former positions as it is tapped, owing to the uneven tension exerted by the bolts.

If the work is eccentrically strapped on the faceplate, weights should be attached in such a position as to counterbalance the weight of the work; otherwise, in most cases, the bored-out hole would not be round. In drilling, boring or reaming, care should be taken to see that no part of the work, straps or bolts will come in contact with the carriage when the lathe is started, as the work might be shifted from its proper position.

In concluding this article it may be well to add that a test indicator should always be used for truing up work that is perfectly round, as the indicator enables it to be trued quickly and accurately, and also gives one the satisfied feeling of knowing that a job that runs true according to a reliable indicator can be depended upon at all times.

*Address: 1029 W. Main St., Waterbury, Conn.

* * *

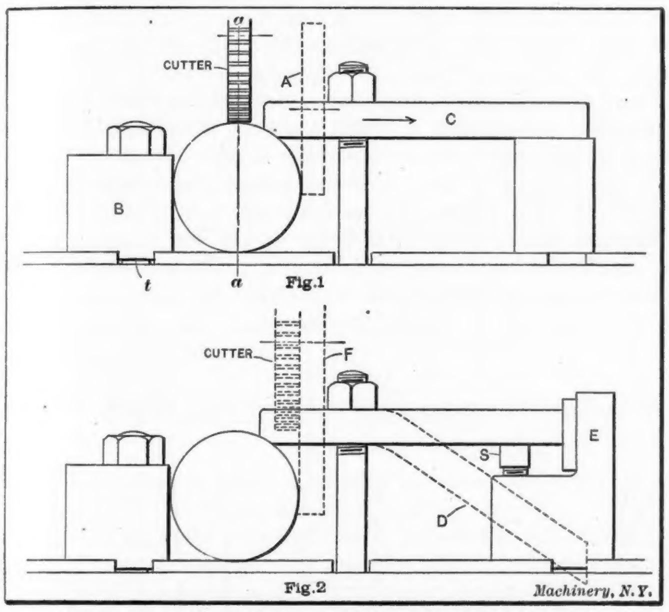
The Ordnance Department of the United States Government follows the practice of placing the inch marks on its drawings over the decimal point in the case of numbers containing fractional parts of an inch expressed as decimals. For example, 10⅛ inches if expressed in decimals on a drawing would be 10."125. The custom seems strange to those acquainted only with the common practice of engineering concerns, but it obviously has an advantage in that there is no mistaking the position of the decimal point.

MACHINE SHOP PRACTICE*

MILLING A KEYWAY IN A SHAFT

The example of milling practice which is the subject of the current Shop Operation Sheet is not unlike many other simple machining operations in that it requires as much care and attention as some work which is more complex.

The first important step in connection with this operation —which is the milling of a keyseat in a shaft—is in clamping the work to the machine platen. The particular method illustrated on the sheet referred to is similar to the one indicated in Fig. 1, there being liner blocks *B* and clamps *C*, which hold the shaft in place. The blocks are brought into alignment by tongue-pieces *t* which fit a T-slot in the table, and the work is held both against the blocks and downward by the oblique pressure from th clamps. As the clamps are



Views Illustrating Methods of Holding Cylindrical Work and Centering Cutter for Keyseating

tightened, they tend to shift backward as shown by the arrow. For this reason clamps having rather close fitting bolt holes should be used. A special packing block, similar to the one shown in Fig. 2, is sometimes used to keep the clamps in place. This block has an extension *E* against which the clamps abut, and also an adjustable screw *S* for varying the height. A tongue-piece which fits a slot in the table, holds the block in position. By the use of a clamp bent as indicated by the dotted lines *D*, any backward movement when tightening can also be avoided, as the end of this clamp rests against the side of the T-slot. The clamps, regardless of the type used, should be placed opposite the liner blocks, as otherwise the shaft might be sprung out of true.

This method of holding a cylindrical piece, while suitable under ordinary conditions, would not be economical if a large quantity of shafts were to be keyseated, as a special fixture in which a number could be held and machined at one time would make a greater production possible.

The next important step in this operation is the centering of the cutter; that is, setting it so that the sides of the cutter are equidistant from a vertical center line *a—a*, Fig. 1, passing through the center of the shaft. One method of accomplishing this is as follows: Set the outer side of the cutter in the same vertical plane as the side of the shaft by holding a scale *F* (Fig. 2) against the outer faces of the milling teeth, and adjust the work until the scale just touches it, as shown; then move the work out a distance equal to the diameter of the shaft minus one-half the width of the cutter. If the cutter runs true and care is taken to hold the scale against the outer ends of the teeth, fairly accurate results can be obtained by this method.

When the size of the shaft will permit, the cutter can be used directly for centering, by raising the work and adjusting it until the side of the cutter barely comes in contact with it, as indicated by the dotted lines at *A* in Fig. 1. The work is then lowered and moved out a distance equal to the diameter of the shaft plus one-half the cutter width.

Still another method of centering the cutter with a cylindrical piece is as follows: Feed the shaft back and forth beneath the cutter until a spot, having a width slightly greater than the width of the keyway, is milled; then with the cutter revolving, set it central with the milled spot. (An illustrated description of this method of centering a cutter appeared in the October, 1909, number of MACHINERY.) The object of having the cutter in motion while adjusting it is to obtain an accurate setting, even though the sides of the cutter run somewhat out of true.

* With Shop Operation Sheet Supplement.

* * *

ALTERATION OF PATTERNS

By C. S. BOURNE*

In almost every shop where various kinds of machinery are manufactured and an endless variety of patterns is used, the conviction often arises in the mind of the machinist who assembles and fits the parts that the proverbial "stitch in time" would, in innumerable instances, have "saved nine" money leaks for the company.

Let us suppose that a shop turns out, from year to year, a variety of machines, but not a great quantity of any one kind. An order comes for a machine that has not been made in the shop for the last year or two. The old patterns are brought from the pattern-room, numbered and sent to the foundry, with the supposition that they are all right. In due time the castings arrive, and, after cleaning, the workman begins his labor of fitting the parts, but has not gone far before he finds that an unusual amount of chipping is necessary to make things "come right." He spends, perhaps, from one-half to a full hour in extra labor, and wonders why that pattern was not corrected at the time the last machine was built. Perhaps the foreman was not informed at the time that the pattern was wrong; perhaps he was informed and it slipped his mind, so the patternmaker was not told about it; perhaps the patternmaker was told, but was very busy just then, and the matter was forgotten.

If it was only one casting that was concerned, the matter might not seem of great importance—but it may be otherwise; a considerable number may be needed, and the extra labor would then be multiplied. Different castings on the same machine may be defective to a greater or less extent, making the sum total of extra labor a serious matter. Now, what is the obvious remedy for this undesirable state of things? My suggestion would be that a general rule be adopted in the shop to the effect that any and every man discovering an error in a pattern should make a note on a card at the time, stating briefly the change to be made, and wiring the card to the pattern. It is then up to the patternmaker to make the necessary change before it goes to its shelf in the pattern-room—not to be used again, maybe, for a year, when it will be found correct. The "stitch in time" has done it.

* * *

High buildings continue to multiply in New York City, where structures twenty stories high long ago ceased to be of unusual interest and importance. The latest candidate for height honors is the Woolworth Building which will be erected at the corner of Broadway and Park Place during the coming winter and spring. From the sidewalk to the top will be forty-five stories, the total height being 625 feet or 13 feet more than the Singer tower, and 75 feet less than the Metropolitan tower. The new building will rest on a rock foundation secured by sinking thirty-eight caissons through the sand 130 feet to bed rock. The total height from the base of the foundation, therefore, will be 755 feet. The building will cost about $5,000,000 and, including the land, the total investment will be something over $7,000,000.

* * *

A international exhibition relating to the iron and machine industries will be held at Budapest in the summer of 1911.

* Address: 53 Mt. Grove St., Lowell, Mass.

DRAWING DEEP CYLINDRICAL SHELLS

By E. P. DAVIS*

It is not very often that a machinist or diemaker is called upon to make a shell of a considerable length, and especially one that is greater in length than the stroke of the press. Therefore, the description given herein will, no doubt, be of interest to many readers of MACHINERY. The shell shown at E in Fig. 1 is similar to that used for holding acetylene gas in an automobile. This shell is 6 inches outside diameter and 19 inches long, and is made from No. 16 (0.0625 inch thick) United States standard gage, hot-rolled steel.

Before proceeding, it is necessary to determine the size of the blank. This is a simple matter if a sample shell can be obtained, as the most accurate way is to cut a circular blank of the desired metal equal in weight to the sample, and then, by adding a small amount to the blank for trimming in the several operations, we have the blank required. If it is not

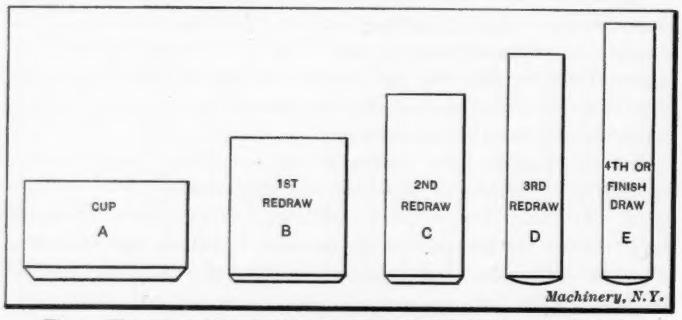


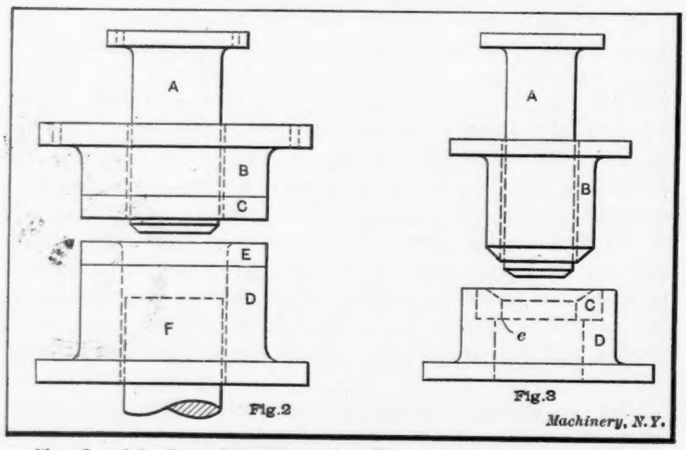
Fig. 1. Illustration showing the Length of the Shell after the Various Drawing Operations

possible to obtain a sample, the diameter of the blank can be determined approximately by the following formula:

$$D = \sqrt{d^2 + 4\,d\,h} \qquad (1)$$

where D equals diameter of blank, d equals outside diameter of shell, and h equals length of shell. In this case the diameter as found by the formula is 22 3/16 inches. By increasing the diameter to 23 inches it will give us sufficient margin for trimming in the several operations.

As it was found not to be economical to cut so large a blank in the first or cupping operation, the steel was ordered from



Figs. 2 and 3. Two of the Dies and Punches used in Drawing the Shell

a mill, cut into squares of 24 inches. Then these squares were taken to a circular power shear where they were trimmed to the desired diameter.

The first press operation is the drawing of the blank into a cup as shown at A, Fig. 1. The outside diameter of this cup is determined approximately by the formula

$$\frac{D}{1.6} = \frac{23}{1.6} = 14.375 \text{ inches,} \qquad (2)$$

but for this case we will say $14\frac{1}{2}$ inches.

The dies used in making this first drawing operation are shown in Fig. 2, where A is the drawing punch made from cast iron and bolted to the countershaft plunger, B is the blank-holder also of cast-iron, but it has a steel ring C fastened to its base, the former being bolted to the toggle actuated slide, the action of which will be described later. D is the drawing die made of cast iron with a steel ring E fastened to its top face. The die D is, of course, clamped to the bed of the press. F is the knock-out which is operated from the toggle shaft located on the side of the press.

In operation the blank is placed on the surface of the plate E; then the blank-holder B descends, holding the blank to the top face of the die with a sufficient pressure to allow the punch A to force the blank into the die without buckling it. As the crankshaft of the press passes the center and is on its upward stroke, the blank-holder B also retreats, allowing the knock-out F to rise and lift the shell out of the die, when the operator can remove it and place another blank in position. The depth of the shell minus a slight amount due to the stretch of the material for each drawing operation can be found by the following formula:

$$L = \frac{B - S}{C} \qquad (3)$$

where L equals the approximate length of the shell, B equals the area of the blank, S equals the area of the outside diameter of the shell, and C equals the outside circumference of the shell. From a table of circumferences and areas of circles found in most handbooks, we find that a circle 23 inches in diameter has an area of 415.476 square inches.

As the outside diameter of the cup in the first operation is $14\frac{1}{2}$ inches, by applying this formula we find that

$$L = \frac{415.476 - 165.13}{45.553} = 5.47$$

or the length is approximately $5\frac{1}{2}$ inches. So that the first

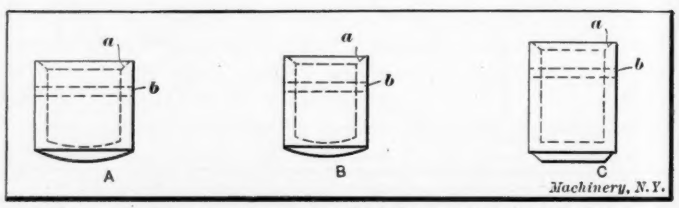


Fig. 4. Auxiliary Punches used in the Third and Fourth Redrawing Operations

drawing operation produces a cup which is $14\frac{1}{2}$ inches in outside diameter by $5\frac{1}{2}$ inches long. After this drawing operation the shell is annealed, and while yet warm is violently shaken and rubbed. It is then placed in a pickling bath which removes the scale. After this it is ready for the second operation or first redrawing operation. The reduction of the shell in this and the successive operations is determined by practical experience more than anything else, as it is a very difficult proposition to know just exactly how much the metal will stretch under the varying conditions.

Allowing for the first redraw a reduction of $2\frac{3}{4}$ inches in diameter reduces the cup to $11\frac{3}{4}$ inches in diameter, and applying formula (3), we find that the shell would be $11\frac{3}{4}$ inches in diameter and approximately 8 inches long. This second drawing operation is performed in the die shown in Fig. 3, where A is a cast-iron punch, B is a holder which fits loosely inside of the cup, and D is a cast-iron die with a steel ring C inserted in it. The bottom edge of B and the top inside edge of C are chamfered to correspond to the angle on the bottom of the shell. The shell is then placed on the die D, when the holder B descends and enters the shell, holding it between the bevel on B and C with a pressure sufficient to allow it to be drawn through the die by the punch A without buckling. As the crank of the press passes the center and is on its upward stroke, the top of the shell catches on the edge e and is stripped from the punch A, falling below the press, where it can be easily removed.

Sufficient metal is trimmed from the shell after each operation to straighten the edge, thus facilitating the following drawing operations. It is also annealed after each drawing operation except the finishing, when it is then trimmed to the desired length.

In the third drawing operation or the second redraw, the

*Address: 162 Poplar St., Bridgeport, Conn.

shell is reduced 2½ inches in diameter, which gives a shell 9¼ inches in diameter and approximately 12 inches long. This operation is performed in a die similar to that shown in Fig. 3, only that it is smaller, of course, to bring the cup to the desired diameter. The fourth drawing operation, or third redraw, allowing 1¾ inch for reduction, reduces the shell to 7½ inches diameter and increases the length to approximately 15¾ inches. The limit of the punch press used was 12½ inches and as the fourth drawing operation produced a shell 15¾ inches in length, an auxiliary punch had to be used as shown at *A* in Fig. 4. This punch is made 4 inches long and is used in the following manner: The cup is placed in position on the die and the punch allowed to descend, and as the stroke is only 12½ inches this does not force the shell completely through the die. The punch is then allowed to ascend again, and the small auxiliary punch shown at *A*, Fig. 4, is dropped into the shell, so that as the punch descends again, it forces the shell through the die. This drawing operation makes the shell 15¾ inches long. The finish drawing operation or fourth redraw, with an allowance of 1½ inch reduction in diameter, makes the shell 6 inches in diameter by 20½ inches long. This is similar to the operation previous to it, but instead of one auxiliary punch being used, two are used as it is not possible to get a punch of sufficient length into the shell. The two auxiliary punches used in this drawing operation are shown at *B* and *C*, Fig. 4. These auxiliary punches are beveled at *a* as shown to conform to the bottom of the punches. A small hole *b* is drilled through these auxiliary punches so that a bent wire can be used for lifting them out of the shell.

* * *

SETTING SCREW MACHINE STOPS

By G. MURRAY

In the October number of MACHINERY an article appeared by "Designer" on setting screw machine stops, in which two methods of setting stops were illustrated. While the writer does not wish to criticise the method shown in Fig. 1, he does consider that Fig. 2 is a rather awkward and inconvenient method, especially when the stock is small in diameter. This would require either an extremely narrow scale, or else necessitate the removal of the chuck, the latter of which is generally very inconvenient. What the writer considers a better method of setting stops is described in the following:

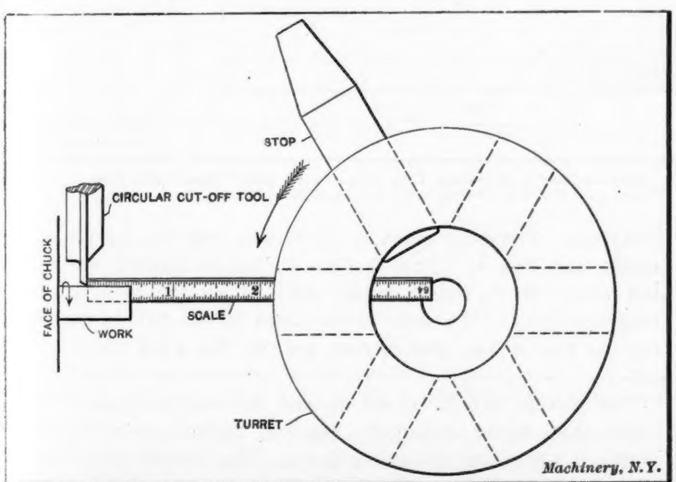


Fig. 1. Method of Setting a Screw Machine Stop

A chuck of the desired diameter is first inserted in the machine and the cap screwed on, then the stock is inserted, and the circular cut-off tool set exactly in the center, and also adjusted so that the tool will produce a square face on the work. After the circular cut-off tool has been set correctly, the chuck is opened by lifting the tripping lever, and the stock fed out the desired length by hand, the length of which can be easily measured by the method shown in Fig. 1.

This is accomplished by inserting a four-inch or a six-inch flexible scale, depending on the size of the machine, into an empty hole in the turret, and bringing one end of it up against the inside face of the circular cut-off tool, as shown. The cut-off tool is brought up against the work by means of the handle used to operate the cross-slide. It is then a very easy matter to set the stock to the desired length. When the desired length has been obtained, the chuck is closed and the turret swung down, so that the stop comes in line with the stock. When the stop is in this position the roll should be on the quick rise of the cam, so that by advancing the cam, the roll will rise up on to the lobe for the stop, thus forcing the stop back into the turret the desired amount, where it can be locked with the lock-screw provided for that purpose.

The method of setting the stop in a turret lathe or hand screw machine would be somewhat similar to that just described; but in this case the slide carrying the turret would be advanced a slight amount, leaving the stop to be forced into the turret about from 1/16 to 1/8 inch, so that a closer setting can be obtained with less trouble.

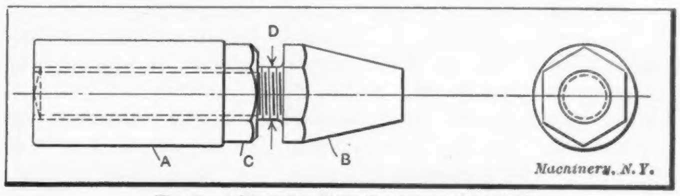


Fig. 2. Adjustable Stop for Screw Machines

When it is necessary to have the length of the piece within a limit of 0.01 inch or less the stop shown in Fig. 1 gives considerable trouble, because the only way it can be set is by tapping it in or out, which is a rather difficult matter at the best.

A stop which gives better results and obviates the difficulty encountered with the former is shown in Fig. 2. The parts *A*, *B* and *C* of this stop are made from machine steel and case-hardened. The body *A* is tapped out for a 20-pitch screw and the diameter is made in accordance with the size of the machine in which the stop is used. The following diameters will be found suitable for the sizes of B. & S. automatic screw machines, as specified: For the No. 00, $D = 5/16$ inch; for the No. 0, $D = 3/8$ inch, and for the No. 2, $D = 1/2$ inch.

For the number 00 the pitch of the thread could be 32 threads per inch, which would mean that one revolution would give a distance of 0.03125 inch. The stop proper, *B*, is made of hexagonal stock, to fit the standard wrenches supplied with the machines. The nut *C* is also made of the same shape and diameter of stock as the part *B*. By having the stop hexagonal in shape, as shown, it would be an easy matter to set it to within 0.005 inch by means of these faces, as the relation of them to the nut can be noted, if the nut is held with a wrench while the part *B* is being rotated.

If suitable means could be provided for clamping and overcoming the thrust of the stock against the stop while feeding out, the ideal stop would be one which could be graduated to read in thousandths of an inch, but as it would be a difficult proposition to make a stop adjustable and also have it clamped effectively, this seems to be out of the question.

* * *

An interesting German method for cutting trees is mentioned in the (London) *Times Engineering Supplement.* The trees are cut by the friction of a steel wire about 0.040 inch in diameter which, as demonstrated by a practical test, is able to cut through a tree of about 20 inches diameter in less than 6 minutes. The wire, which is moved back and forth by means of a device driven by an electric motor, is heated by the friction against the wood to such an extent that it burns through the timber, the cut thus being both smoother and cleaner than when effected by a saw. The motor actuating the wire is installed outside of the range of the tree when it falls.

* * *

Many a machinery salesman only wishes he could get orders for machines as easily as many a foreman and machine operator thinks he can. Many a machine operator wishes he had as easy a time of it as he imagines the average machinery salesman has. It is simply a case of one fellow envying the other because he doesn't know the other's trials and tribulations.—*The Wood-Worker.*

We pay only for articles published exclusively in MACHINERY.

GRINDING ADDING MACHINE SIDE FRAMES

The articles on the Ellis Adding typewriting machine by R. E. Flanders have undoubtedly been interesting to a great many readers of MACHINERY, especially those who are directly connected with adding machine and typewriter manufacture. The intricate and delicate mechanisms required in their construction must be made so accurately that the thought of the impracticability of the tools "standing up," is an ever-present one. The term "interchangeable manufacture" must be lived up to, and the tools used cannot be made too accurate or too efficient.

The various methods of machining the side frames of this machine, described in the September number of MACHINERY, are especially interesting to the writer, as they bring to his notice the methods used in manufacturing machines of other makes. In the description of the method used in machining the side frames, it was stated that the vertical grinder is used. Of this machine tool, very little has been written by contributors, but it is to be hoped that, in time, interesting articles describing various fixtures and appliances used in connection with this machine, will be forthcoming. The ideas imparted will be greatly appreciated by users who have experimented in many ways to obtain accurate work.

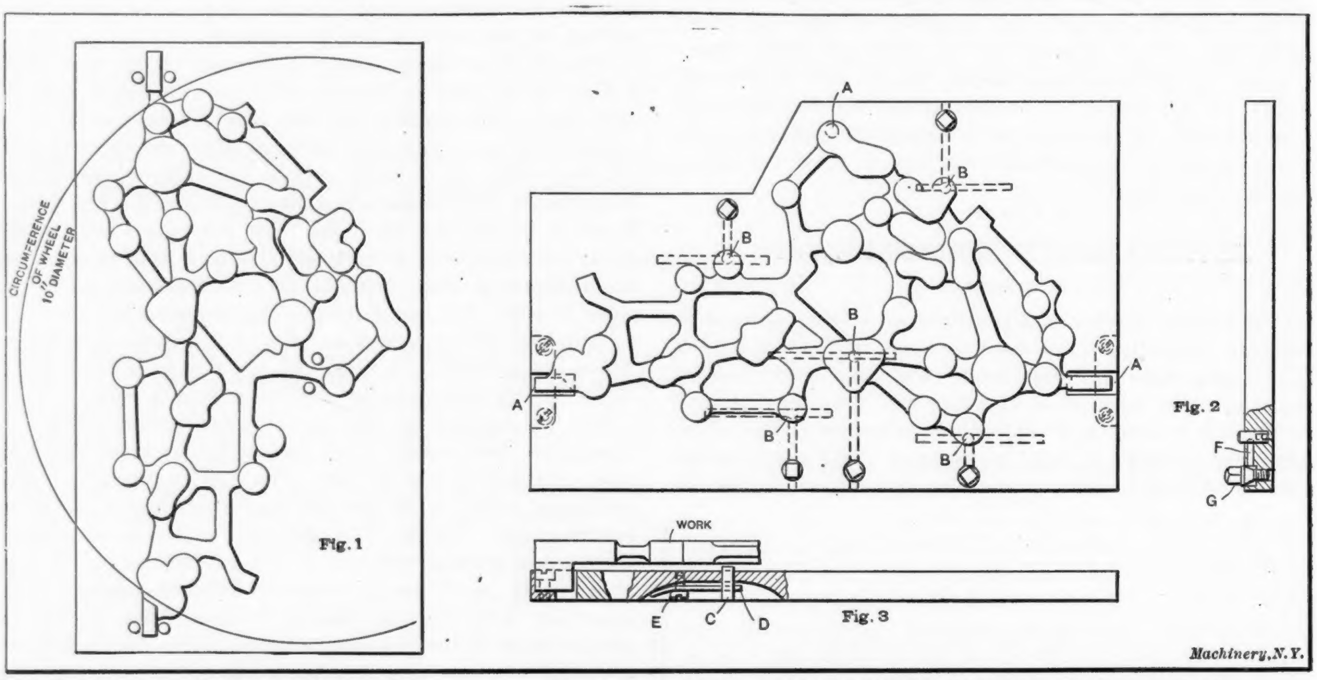


Fig. 1. The Fixture used in Finishing Both the Right- and Left-hand Frames to the Desired Thickness

Figs. 2 and 3. Fixture used in Finishing One Side of One Side Frame only, One Fixture of this Kind being used for Each Side Frame

The writer having had numerous problems to deal with in connection with this grinder, will endeavor to illustrate the method used in machining work similar to the Ellis adding typewriting machine.

According to Mr. Flanders, a disk grinder is used on one side of the frames to obtain one flat side, flat enough for the magnetic chuck to hold it properly. The writer fails to see the advantage gained by this method. In the first place, it is a difficult matter to obtain a flat surface by the above method, and in the second place if it is not ground perfectly true, by placing this finished side on the chuck, the casting will spring when the current is applied, and when released will assume its original position or nearly so.

The method used by the writer in machining the side frames is illustrated in Figs. 1, 2, and 3. Figs. 1 and 2 are the fixtures used, both being placed on the magnetic chuck in the manner shown in the illustration. The idea in so doing is to obtain a frame finished on both sides at one setting or grinding. Fig. 1 is called the sizing fixture and Figs. 2 and 3, the fixture for grinding one side frame only, two fixtures being used one for the left-hand side and the other for the right.

Referring to Fig. 2, it will be noticed that the work is resting on three positive points, *A*, and supported by the spring pins *B*. One would naturally think that the magnetic chuck would have force enough to draw the remaining bosses toward it, so as to distort the frame, but it does not, owing to the fact that the work is placed far enough away, so that it has no effect on it whatsoever. All the chuck does in this case is to hold the fixture. The cross-sectional views show how the spring pin is made. The pin *C* has a hole at one end in which the spring wire *D* is placed. The wire is located in the saw slots in the fixture and is secured by screw *E*. The method of locking is shown in the cross-section of the end elevation, *F* being the locking bolt, and *G* the locking screw which operates it.

In operation, before placing the side frame in the fixture, all the spring pins are depressed and locked. Then the casting is placed on the positive points and a weight is placed on it, bearing only on the points directly over the positive locations. The next move is to release each spring pin separately and lock it. This is done to insure against springing the work, which would surely occur if all the pins were released at once. The slots in the sides of the fixture in which the two lugs of the casting rest, prevent the work from sliding off.

The current is now turned on and this side is ground, about 0.025 inch being removed. Having ground this side, the frame is placed in the sizing fixture, Fig. 1 with the finished side down, and located by the pins shown. Then another casting is placed in the other fixture in the manner previously explained. The wheel is now brought as far as the circle shown in the sketch, or as far as the lugs will permit, and the piece finished on this side, at the same time that the one side is finished in the other fixture. A small piece of casting (coppered) is placed on the finishing fixture for a gage, to show when the proper thickness is reached. As the wheel wears slightly, the operator can feed down to the previous setting without danger of cutting away too much material; then as soon as the wheel starts to cut the copper from the gage, he will know the proper size has been obtained.

The above method of machining flat surfaces has proved so successful, that in numerous cases, the patterns have been changed to allow less stock for finishing, and the grinder used in the place of the milling machine. In grinding, less stock

is removed, and there is consequently less liability to distort the casting, while in milling, a sufficient amount must be left on the casting to insure the tools standing up, and to allow them to get under the scale properly.

The matter of selecting proper wheels is a difficult one. Some are too hard, some too soft—so soft in fact that they wear out very soon—while others are so hard that they load up quickly and heat the work rapidly. The writer has found that when a wheel is too hard and glazes, better progress will be made by recessing or under cutting it so as to leave a cutting surface of about ¼ inch, and it will not require redressing so often.

The writer would like to hear how other users of the vertical grinding machine are solving problems in accurate machine work of this character. A. C. LINDHOLM

New Haven, Conn.

METHOD OF MAKING DUPLICATE SKETCHES

The drafting department is very often called upon to make a pencil sketch of special work for a rush job, and is expected to have it completed in the shortest possible time. In many cases, these sketches are for work that is to be done outside of the factory, or are for the use of the sales department at some agency—sometimes several hundred miles away.

As everyone knows, mistakes are easily made in mechanical work as in everything else, and someone is expected to bear the blame. The drafting or designing department will, in nine cases out of ten, be the department which will receive, sooner or later, the credit for the mistake, and consequently, should have some means for keeping accurate records of rough sketches, data, etc., as well as for tracings and blueprints.

The writer has devised a system of sketch sheets for this purpose. By means of these sheets accurate duplicates of the original sketch are kept, and may be filed away for future reference. They consist of sheets of a cheap grade of bond paper, cut to the size most adaptable to the work of the factory using them, and are printed and lined as shown in Fig. 1. These sheets can be placed on the drawing board with carbon paper placed between them, so that each sheet will be an accurate record of the original drawing. As many as four copies may be made in this manner. Where it is not desirable to make blueprints, or where no means are at hand for doing so, this method will usually be found very useful.

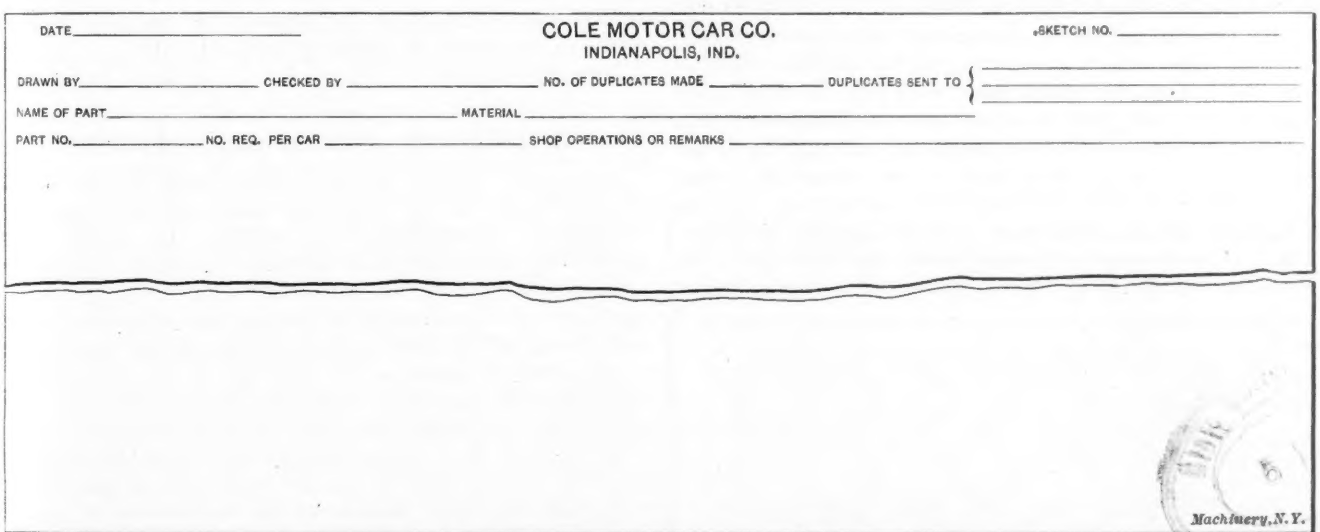


Fig. 1. Sheet used in Making Duplicate Sketches, Size 18 by 12 inches

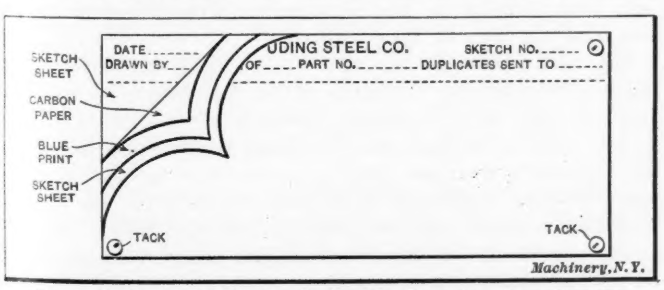


Fig. 2. Method of Making Duplicates of a Blueprint where Changes are to be made

In tracing over an old drawing, where changes are to be made, bond paper is also recommended. To do this, a sketch sheet is placed on the board, then a sheet of carbon paper is placed over it, next to the blueprint to be changed, and lastly another sheet of bond paper as shown in Fig. 2; this will give two copies of the changes made. F. B. HAYS

Indianapolis, Ind.

A FEW SUGGESTIONS TO DRAFTSMEN

Although it may seem to be too simple a matter to write about, it is, within the writer's observation, a fact that few draftsmen tack tracing cloth to a drawing-board according to any logical method. If the following procedure is adopted, the cloth may easily and quickly be placed, without wrinkling. Put the first tack in the middle of the top margin of the cloth. Then smooth the cloth with the palm of the hand downward to the middle of its bottom margin, and fasten it there with a tack. This makes the cloth taut vertically through the middle. Now, smooth out from the center to the middle of one of the side margins, fasten with a tack at this point, and repeat for the other side. The cloth is now tacked at the middle of each of its edges. Finally, smooth out the cloth from the center to each corner and tack there. In this procedure the cloth is always smoothed from the center outward; consequently no wrinkle or fullness is left.

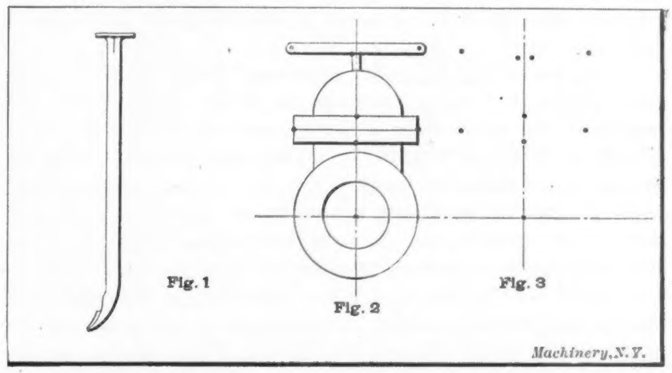


Fig. 1. A Convenient Lifter for Small Tacks Fig. 2. Drawing to be reproduced Fig. 3. Method of Duplicating Drawing

Thumb-tacks are objectionable on account of their interference with the T-square and triangle. It is a good plan to use, instead of these, plain cut tacks of the smallest size obtainable. These may be driven into the drawing-board with a small tack hammer kept for the purpose. If the cloth is stretched on the drawing-board according to the foregoing directions, as many additional cut tacks may be used as the size of the drawing warrants and no difficulty will be found in working over them with a T-square. Having once fastened the sheet, it will be unnecessary to remove it until the

drawing is finished. If the cloth should swell in damp weather, it will, when dry, return to its register with the paper drawing, because the cut tacks make a very secure fastening—vastly better than the thumb-tacks. For removing the tacks, a tool similar to that shown in Fig. 1 may be used. This is a tenpenny nail with its end hammered to a chisel point and shaped as shown.

It is a poor plan to trim drawings made on tracing cloth with shears or a knife. It is difficult to follow a straight line with shears, and a knife, if used with a straightedge, is likely to cut either it or the drawing-board. Take a large darning needle (which may, if desired, be furnished with a wooden handle into which the eye end of the needle is inserted) and run the point of it along the line upon which the tracing is to be trimmed, guiding it with the T-square edge. This will cut the cloth on a nice, straight edge, and will not mar the drawing-board if Manilla paper separates it from the cloth.

I have found the following described device to be of great convenience in making drawings in which small details are repeated. An illustration will best serve to explain it. It is desired to make the drawing of a gate valve, such as is shown in Fig. 2, a number of times. It is first drawn upon a small piece of tracing cloth and a number of points, such as corners, circle centers, etc., are marked with a prick point as indicated, these points being selected so as to enable one to repeat the drawing by their aid. This "jig" is laid upon that part of the drawing which it is desired to repeat and holes pricked through at the marked points. Fig. 3 shows the results from which it is easy to duplicate Fig. 2. By using such a jig, repeated details may be omitted from the pencil drawing, the points being pricked on the tracing and the drawing inked in without penciling. JULIAN C. SMALLWOOD

Syracuse, N. Y.

LAYING OUT BLANKING DIES TO SAVE METAL

In the October number of MACHINERY there was an article describing a die with an automatic stop for blanking washers, where the holes in the metal strips shown in the illustration appear to have been laid out at an angle of 45 degrees. This the writer considers a waste of stock, and although he is not criticising the stop or other parts of the design, he would like to draw the reader's attention to the correct way of laying out blanking dies for washers or work of a similar character.

Fig. 1 shows a strip of metal in which the holes have been laid out at an angle of 45 degrees, while Fig. 2 shows another

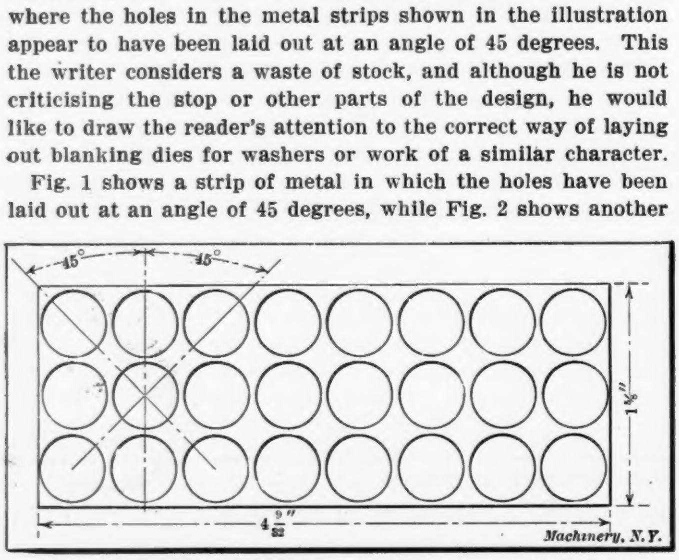


Fig. 1. Condition of the Metal Strip after Blanking in a Die laid out at an Angle of 45 Degrees

strip of metal in which holes of the same diameter as shown in Fig. 1 are laid out at an angle of 30 degrees. By comparing these two strips of metal it can be seen that in Fig. 1 twenty-four washers can be cut from a strip which is 4 9/32 inches long by 1⅝ inch wide; while the strip shown in Fig. 2, which is 4 9/32 inches long by 1 15/32 inch wide, will give twenty-three washers, and also two half washers. In reality the latter strip would give twenty-four washers, as the usual strip of metal is considerably longer than that shown, and, of course, in a long strip no half washers would be cut, except at each end.

To more clearly illustrate the difference in the two methods of laying out a die, we will calculate the area of the two strips, and see the amount of saving in stock which would be gained in making 1000 washers when the dies were laid out at an angle of 45 and 30 degrees respectively. When the die is laid out at an angle of 45 degrees, and the strip is as shown in Fig. 1, the number of square inches of material required to make 1000 washers would be 4 9/32 × 1⅝ × 1000 ÷ 24 = 289.87 square inches. When the blanking die is laid out at an angle of 30 degrees, and the strip is as shown in Fig. 2, the number of square inches required for 1000 washers would be 4 9/32 × 1 15/32 × 1000 ÷ 24 = 261.71 square inches. Then the amount of metal saved by laying out the die at an angle of 30 degrees instead of 45 would be 289.87 — 261.71 = 28.16 square inches. This, as can be seen, is a considerable saving of metal, and where a large number of blanks is required the saving would, of course, be more noticeable.

By way of further explanation the writer will say that the holes in all classes of dies for cutting any size or any amount

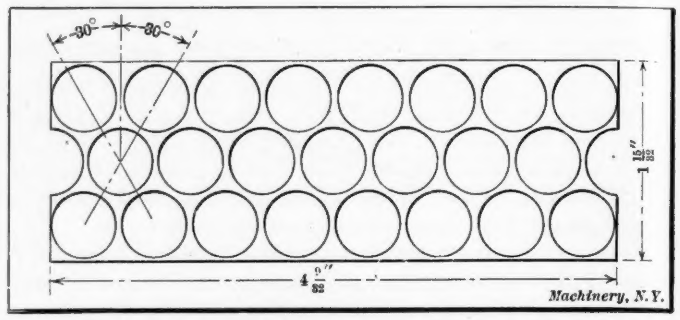


Fig. 2. Condition of the Metal Strip after Blanking in a Die laid out at an Angle of 30 Degrees

of round blanks at one time, should be laid out at an angle of 30 degrees with each other in order to get the greatest number of blanks from the least amount of metal. Of course, in all cases it is necessary that the narrow bridge between each hole should be equal to the thickness of the metal; and that the distance from the center of one hole to the center of the other be equal to the diameter of the hole plus the width of the bridge of metal between the holes.

Waterbury, Conn. CHAS. DOESCHER

HOMEMADE AUTOMOBILE MAKING

Automobile building is not confined alone to the regular manufacturers but the craze has taken hold of a number of individuals—machinists and others—who have worked in an automobile factory and who all think they have a fair knowledge of how to build an automobile. The majority of them have not the wherewithal to purchase an automobile, so the only thing left for them to do is to make a few patterns, get a few castings, spend a few evenings on the machining of these castings, do a little wood-working, and after the expenditure of a few dollars they have the machine under way.

A man may be a high-grade machinist and toolmaker and may have spent years in the toolroom of an automobile factory, and thoroughly understand the construction of patterns and the molding of them; nevertheless these qualifications do not make him competent to undertake the building of an automobile. Again we have the so-called "handy man" who after operating a cylinder-boring machine or an automatic screw machine, etc., in an automobile factory, thinks that he has experience enough to start building an automobile for himself, incorporating in his construction improvements which will open the eyes of the "regulars."

The writer, who put in about five years in the pattern and foundry departments of a large automobile factory in Detroit, and also has devoted several evenings a week to "charity" pattern making, on parts for homemade automobiles, feels that his experience warrants him to give a bit of advice to those contemplating making a homemade automobile. Go ahead, provided, however, that you have the patience, time, tools and "money to burn" and that reverses and disappointments land on you, as water on a duck's back.

The design and proportions of the cylinder are very important, and if you wish to copy another standard make of cylinder, this is well and good. Next comes the pattern and core-boxes for the cylinder, and these must be correct. By

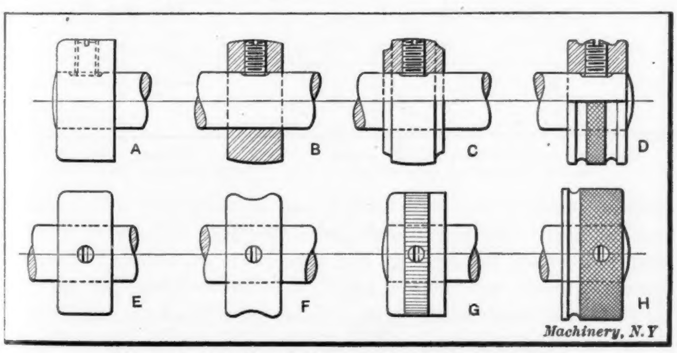
"correct" the writer does not mean that the pattern and core-boxes should have a high-grade piano finish. They must be practical for the molding and core-making; and the placing of the cores in the mold is also an important point. The making of the pattern for an automobile engine cylinder, and the successful casting of it require the services of a first-class mechanic, so do not expect the foundry to turn out a good cylinder casting from inferior patterns and core boxes; you are very fortunate if the foundry proprietor accepts the job of casting your cylinders at all.

The writer thinks he is correct in saying that no foundryman who has had any previous experience in automobile engine work will accept a job of this kind unless business is slack or a special price is made which will warrant him to take chances on turning out a perfect cylinder casting, so that his profits will more than cover the casting losses. Some readers may say: "If the foundry foreman understands his trade, he should know how to make a perfect cylinder." The very fact that he does understand his business is the reason why he will not accept gas engine cylinder work, unless the customer is willing to guarantee against any financial losses. The writer knows of two firms in Milwaukee who will not accept gas engine cylinder work (automobile cylinders) at any price. Five machinists, friends of the writer's, are building automobile engines and he has personally followed up the work on the cylinders. The first man received and partially machined six cylinders before getting even a fair one. The second man received seven cylinders and the third, eleven cylinders. This latter man got a good cylinder after waiting and working seven weeks. This should be a lesson to any young or inexperienced mechanic who attempts building an automobile, and the writer will conclude by saying not to attempt building an automobile unless you purchase the machine parts, and are willing to spend time, patience and money in assembling.

EXPERIENCE

COLLARS FOR SMALL MACHINE WORK

The collars shown in the accompanying illustration will be found very useful for small machinery. They are made from cold-rolled steel in an automatic screw machine where they can be finished complete except for the drilling of the hole for the set-screw. Of course, this hole could also be drilled



Stop and Adjusting Collars for Small Machine Work

by means of a cross-drilling attachment, but it would be necessary to tap the hole for the set-screw elsewhere, so that very little would be gained by drilling the hole in the screw machine. The collars *A*, *B*, *C* and *D* are used to retain movable parts and are fastened to the shafts by the set-screws shown, the shafts having small flats filed on them. Sometimes flats are not provided on shafts for the set-screws, but this is not good practice. The collars *E*, *F*, *G* and *H* are what are commonly called stop collars. These are used for limiting the movement of shafts, such as a belt shifter, etc.

These collars are of simple design and can be made much cheaper in the automatic screw machine than by making them of cast iron as is sometimes the custom.

Buffalo, N. Y. LAWRENCE H. GEORGER

RECESSING TOOL-HOLDER FOR SCREW MACHINES

The accompanying illustration shows a recessing tool-holder for screw machines which is of very simple design and can be cheaply made. Fig. 1 shows end and side views of this recessing tool-holder. The shank is made to fit the hole in the turret, and is of machine steel, casehardened. A detailed view of this shank is shown at *A* in Fig. 2, and a detail of the cap or cover at *B*. Two lugs *C* and *D*, shown in detail in Fig. 3, are fastened onto the head *B* with screws; one lug holds the screw *a*, which acts as a stop, and the other

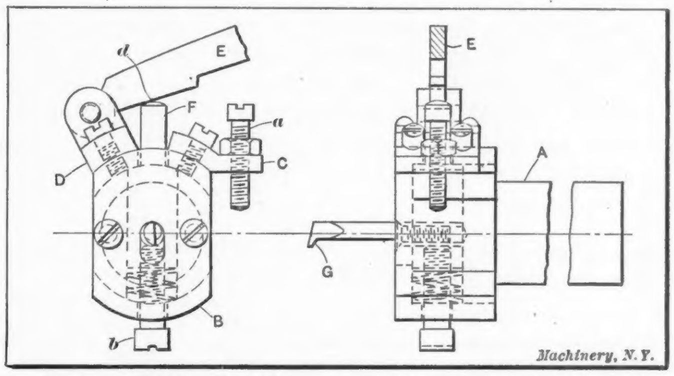


Fig. 1. A Recessing Tool-holder of Simple Design for Screw Machines

holds the handle *E*. A detail of the recessing tool and the tool-holder are shown at *G* and *F* in Fig. 3. The recessing tool *G* is held in the tool-holder *F* by the screw *b*. A spiral spring shown in Fig. 1 bears against the shoulder *c* of the tool-holder, keeping it out against the cap *B*, as shown.

For hand screw machines this tool is operated as follows:

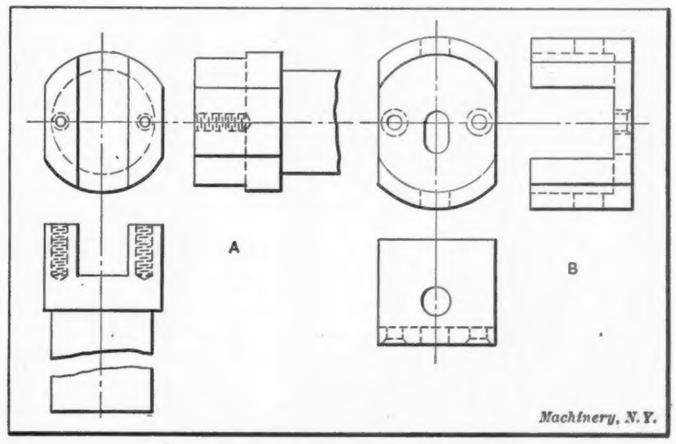


Fig. 2. Detail Views of the Shank and Cap

The recessing tool *G*, which is concentric with the hole in the work, is advanced in the hole the desired distance; then the handle *C* is depressed, being stopped by the screw *A* when the desired depth is reached. The turret can then be advanced horizontally until the desired amount of recessing is completed.

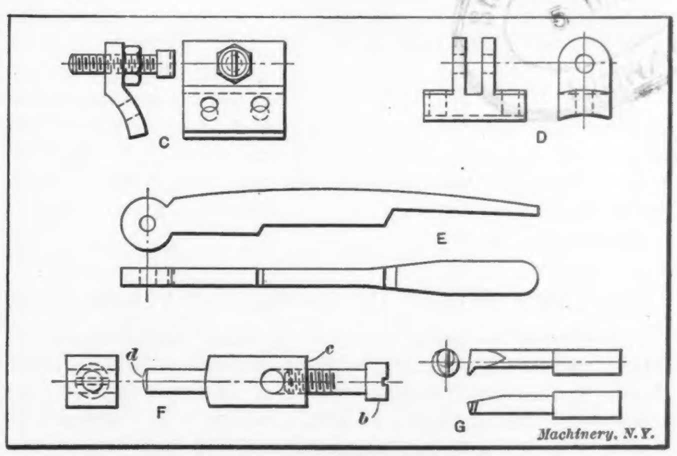


Fig. 3. Detail Views of the Brackets, Handle, Tool-holder and Recessing Tool

For automatic screw machines the parts *C*, *D* and *E* are removed, and a cam block is attached to the cross-slide tool-holder. This cam overlaps the tool-holder and is in such a position that it presses against the end *d* of the recessing tool-holder *F*. The cam held on the circular toolpost is made of the shape that it is desired to produce in the work.

One advantage of this tool is that the rise on the cross-slide cam equals the distance that the tool is to be moved, thus avoiding the calculations which are necessary when a swing tool is used for recessing JETHART

MAKING BLADES FOR INSERTED-TOOTH MILLING CUTTERS

The making of the blade shown in Fig. 1 was at one time considered a difficult proposition. These blades were made from "Intra" steel, and it was necessary to reduce the part *A* so that it would fit in the slots cut in the milling-cutter body. The limits on the thickness were from 0.122 to 0.124 inch. The blades were at first ground in a suitable fixture on a machine of the swinging-arm type, and as the pieces varied somewhat in thickness, heavier cuts were required to be taken on some of the pieces, so that these varied considerably from the others, on which light cuts were taken. This method was discarded and the following method was adopted. A special fixture which had been used for another purpose was fastened to a Lincoln miller, as shown in Fig. 2. This fixture consisted of a casting carrying a worm-wheel and chuck, and a shaft with a worm and pulley attached to it. The pieces to be milled were held in this chuck by set-screws as shown at *A* in the illustration. The chuck was driven by a pulley through a worm and worm-wheel, the pulley being driven directly from the 1¼-inch countershaft. This arrangement gave the desired feed. The ratio of the worm and worm-wheel was 1 to 40.

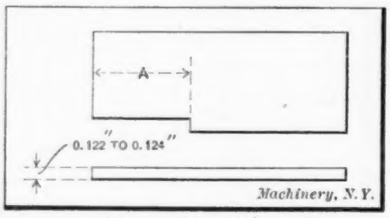


Fig. 1. Blade for Inserted-tooth Milling Cutter

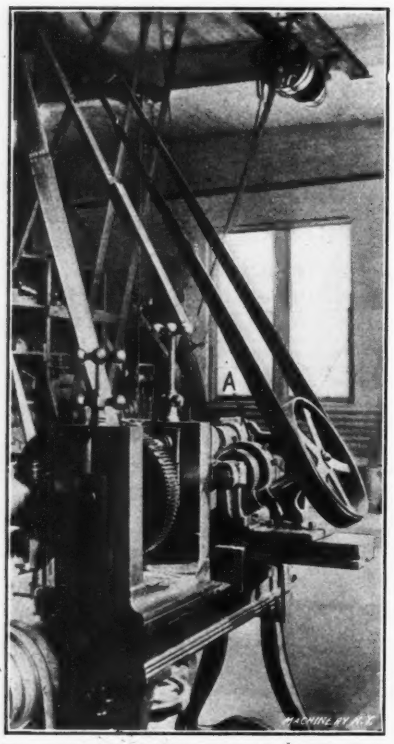


Fig. 2. Lincoln Miller equipped with Special Device for Milling the Blades

This fixture rotated slowly enough, so that the operator could keep filling it up and removing the blades as they were milled. The milling was done by straddle mills of the ordinary type. This method was found to be very efficient and none of the blades varied more than 0.0005 inch in thickness. DONALD A. HAMPSON

Middletown, N. Y.

DRILLING HOLES IN DIFFICULT POSITIONS

It frequently happens, especially in repair work, that a hole has to be drilled in a piece which breaks through, or in other words, is not supported at all points of its circumference. An example of this is shown in Fig. 1 where it is necessary to drill a hole for a ⅜-inch screw in a rib ¼ inch wide. The difficulty is very easily overcome by clamping two strips *A*, as shown, on each side of the web; the strips help to support the drill and guide it true.

Another example somewhat similar to that shown in Fig. 1, but where the hole only breaks through on one side of the piece, is shown in Fig. 2. Here one strip *A* is clamped on the side of the work, and the hole *C* can then easily be drilled.

An example differing slightly from those just described is shown in Fig. 3. Here it is necessary to countersink screw holes *M* in a cover which is to fit over a chamber, the inside of which is indicated by the dotted lines *J*. It can easily be seen that to make these countersunk holes with an ordinary countersink which is not supported would be a difficult proposition, as, having no support, the countersink would run to

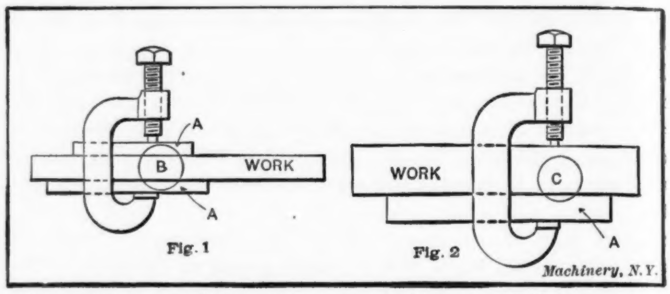


Fig. 1. Method of Drilling a Hole which breaks through on Both Sides Fig. 2. Method of Drilling a Hole which breaks through on One Side

the outside. To overcome this difficulty two strips *A* are held on the sides of the cover by a clamp as shown, so that the holes can be countersunk without any further trouble. When the screws are put in place, of course, they will project over the edge of the cover, but they can be easily filed off flush which will make a neat enough job for some purposes.

When it is necessary to make an elongated hole in a piece of work, as shown in Fig. 4, the usual method is to drill two holes the required distance apart and then chip or file out the intervening web. Now when the distance *L* is one-third greater than the distance *K*, or the diameter of the drill required, some means will have to be provided for drilling the second hole. To accomplish this, the hole *F* is first drilled and two small notches, *E*, are filed in it as shown. Then a piece of stock which is a tight fit is driven into the hole *F* and riveted over, so that the riveted portion of the stock will form small projections which fit into the notches *E* and prevent the plug from turning. After this is done the hole *G* can easily be drilled and the plug removed, so that it is only necessary to cut away the small ribs to complete the elongated hole *D*.

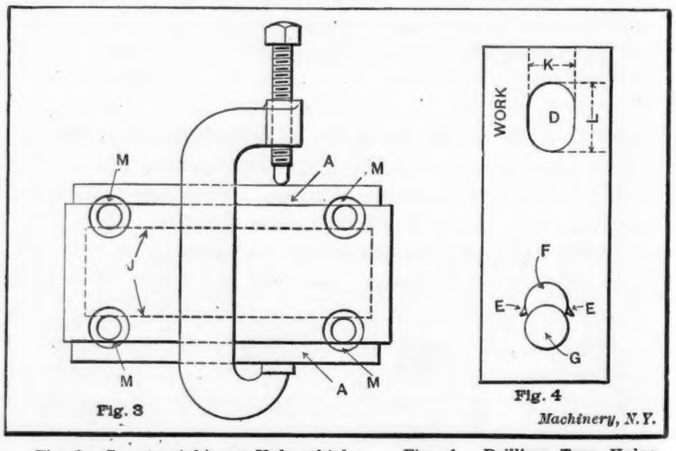


Fig. 3. Countersinking a Hole which breaks through on One Side Fig. 4. Drilling Two Holes which run into Each Other

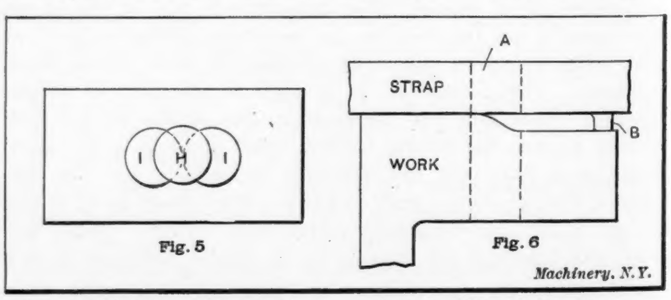


Fig. 5. Drilling Three Holes in the Same Manner as in Fig. 4 Fig. 6. Drilling a Hole which starts on a Radius

Fig. 5 shows another example, which is similar to that shown in Fig. 4, except that the slot is to be twice as long as the diameter of the drill. To accomplish this, the two holes *I* are first drilled and then plugged as was mentioned regard-

ing Fig. 4. It is then an easy matter to drill the hole *H*, which leaves very little material to be filed or chiselled out to complete the slot.

Every machinist who has had much experience with drilling holes in cast iron knows that blow holes are frequently encountered. The writer had an experience like this at one time and overcame it in the following manner. All the chips which had been collected in the hole from drilling were removed and some of the hardest babbitt he could find was melted and poured into the hole, so that the blow hole in the casting was completely filled. The drill was again run in and the hole completed with satisfactory results.

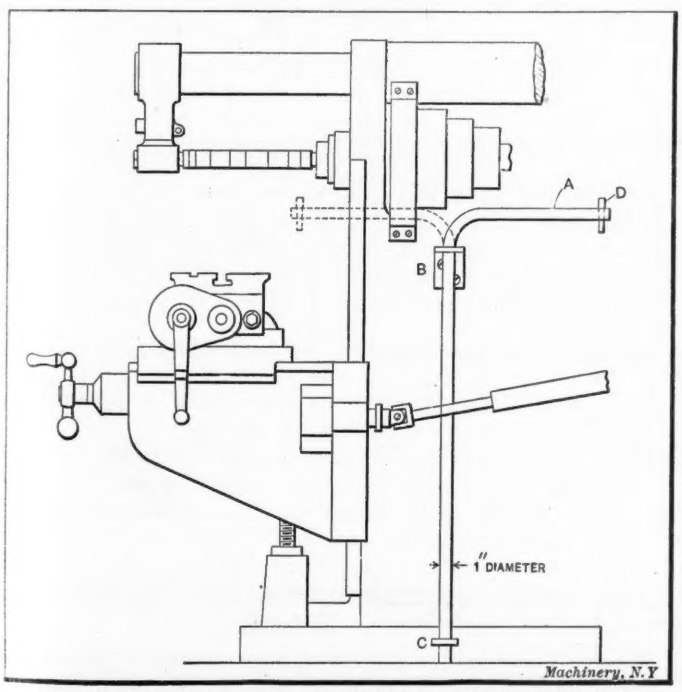
An example of a very difficult job is shown in Fig. 6. Here it is necessary to drill a hole where the point of the drill starts on a radius, so that it is practically impossible to keep the drill in a perpendicular direction. There are two or three methods by which this could be done, one of them being, to chip a flat surface in the work so that the drill point could get a good start; by using a small drill it would then be possible to make the larger drill follow the hole previously made.

Another example, which is shown in Fig. 6, is to clamp a strap onto the work which has a hole *A* of the required diameter in it, and drill through it. The strap is packed up on its outer extremity by a small plug *B*, so that it will be held perfectly parallel. By using the hole in this strap as a guide, the hole in the work can be easily drilled. Of course it will be necessary to start the drill very slowly.

Newark, N. J. H. E. Wood

DEVICE FOR REMOVING AND REPLACING THE DIVIDING HEAD OF A MILLING MACHINE

To those who have occasion to use a universal milling machine often, the frequent changing of the dividing head is usually a difficult task, owing to its weight and also to the delicacy of its mechanism which may very easily be seriously damaged by a fall. On the larger size of milling machine it requires two men to successfully handle the dividing head. To eliminate this extra labor and risk of a disastrous fall, the



A Simple Device for Removing and Replacing the Dividing Head of a Milling Machine

attachment shown in the accompanying illustration was made, and was found to be very efficient.

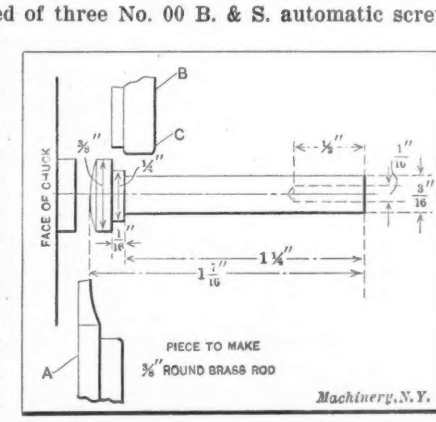
This attachment is composed mainly of a rod and two brackets. Attached to the rear of the machine by two 3/8 by 1-inch countersunk-head screws which are tapped into the column is a bracket *B* made from 5/16 by 2-inch mild steel. A lug *C* is also tapped into the base of the machine, this lug being a piece of 1/2 by 2-inch mild steel, with one end turned down to 1/2 inch diameter and threaded 3/4 inch long. Holes 1 1/64 inch diameter are drilled in the brackets *B* and *C*, in which is inserted a crane bar *A* made from 1-inch diameter cold-rolled steel, bent to the form shown.

In one end of this crane bar *A*, a 1/4-inch hole is drilled for the pin *D*. This pin prevents the dividing head from slipping off the bar when it is being removed or replaced. The dotted lines in the illustration show the position of the crane bar when removing the head and placing it on the machine table. In operation the milling machine table is lowered or raised until the hole in the dividing head coincides with the crane bar. The head is then slipped on the end of the bar and the table moved over until the head is safely on the frame, when the pin *D* is inserted. The table is then lowered until the crane is free to move around to the position shown by the full lines. Corwin Lamoreaux

Aurora, Ill.

MAKING A LARGE STUD ON THE NO. 00 B. & S. AUTOMATIC SCREW MACHINE

A small factory desired to manufacture the brass stud shown in the accompanying illustration. Their screw machine department consisted of three No. 00 B. & S. automatic screw machines, two being old and one new. This stud, it will be noticed, is made of 3/8-inch round stock and is turned to a length of 1 1/4 inch. Both of these dimensions were beyond the limit of the old machines, but the new machine took a 5-inch lead cam instead of 4 1/2 inches. This allowed us to turn the long portion. The new machine also can be geared to make a piece as low as ninety-one seconds. The 3/8-inch stock was handled by boring out an ordinary feed tube to clear the stock and soldering the feed finger in the end of it. The maximum distance between the turret and the end of the spindle on the old-style machine is 2 3/4 inches. This has been increased to 3 inches on the new machine, which allows more room for box-tools, etc., on long pieces.



View showing Application of Circular Tools used in making Large Stud

In the illustration, *A* is the cut-off tool and *B* the form tool. The corner of this latter tool is rounded off as shown at *C*, which leaves a smooth finish where the box-tool and the form tool meet.

The order of operations for this piece are as follows:

Order of Operations	Revolutions	Hundredths
Feed stock to stop	41	3
Revolve turret	41	3
Center, 0.040-inch throw, at 0.001-inch feed	41	3
Revolve turret	41	3
Drill, 0.510-inch throw, at 0.001-inch feed	510	37
Revolve turret	41	3
Ream, 0.510-inch throw, at 0.005-inch feed	102	8
(Form, 0.100-inch throw, at 0.001-inch feed)	(102)	(8)
Revolve turret	41	3
Box-tool (roughing), 1.250-inch throw, at 0.008-inch feed	156	12
Revolve turret	41	3
Box-tool (finishing), 1.250-inch throw, at 0.00606-inch feed	206	15
Cut-off, 0.208-inch throw, at 0.002-inch feed	104	8
(Revolve turret)	(41)	(3)
Total number of revolutions for one piece	1365	100

This lay-out, using a spindle speed of 2048 revolutions per minute, gives a gross production of nine hundred pieces in ten hours, or forty seconds for one piece. I might mention here that the gears on the new-style No. 00 B. & S. machine for pieces made in less than thirty seconds are compound, the same as on the No. 2 B. & S. machine. The gears for the

above job are 20 teeth on driver, 30 teeth first gear on stud, 40 teeth second gear on stud, and 60 teeth gear on worm shaft.

The maximum surface speed of the stock on this job is 201 feet per minute, and the maximum surface speed while drilling and reaming is 33 feet per minute. A faster speed could have been used for these two operations, but we save time by forming while drilling. This would not be possible with a faster speed. The form tool is used to finish the shoulder to the exact length.

It is possible to make long pieces on the old machine by box-tooling, etc., close to the spindle, then feeding out and forming, but the pieces will not be accurate because two diameters have been turned at different chuckings.

AJAX

IMPROVED ANGLE-PLATE FOR LATHE WORK

It is not an unusual occurrence in the use of the ordinary type of angle-plate in the lathe to have the corners strike the ways of the lathe when pieces of large or irregular shape

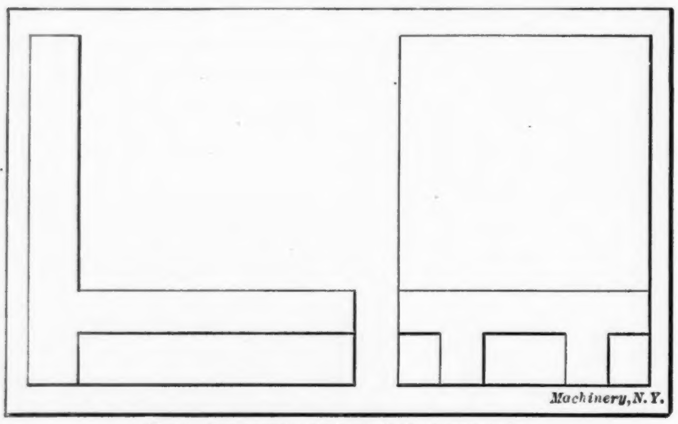


Fig. 1. Improved Angle-plate for Lathe Work

are strapped to it. This trouble may be obviated by the use of an angle-plate of the shape shown in Fig. 1. The advantages obtained by this angle-plate are as follows: The work can be strapped to the plate before the plate is fastened to the faceplate of the lathe. This will be found very convenient when work of difficult or irregular shapes is to be machined. Having the angle-plate made in this manner balances the faceplate and thus obviates the necessity of strapping balance weights to it. It is also a very convenient plate for bench work, as it has all its surfaces finished and square with each other, which makes it very useful in laying out work. At *A* and *B* in Fig. 2 is shown the advantage of this plate over the ordinary type of angle-plate. At *A* is shown the new plate, and the face on which the work is to be held is five inches from the center so that the extreme corner of the angle-plate clears the ways of the lathe. At *B* in Fig. 2 is shown the

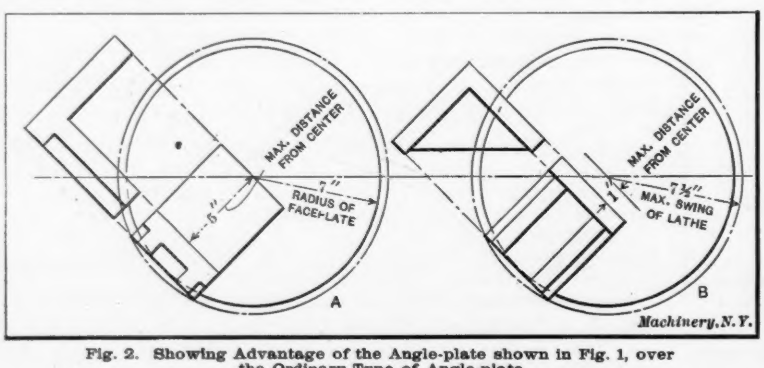


Fig. 2. Showing Advantage of the Angle-plate shown in Fig. 1, over the Ordinary Type of Angle-plate

angle-plate of the ordinary type on the faceplate, and it is seen that for the angle-plate to clear the ways of the lathe, the maximum distance which it can be set from the center is only one inch. This shows clearly the advantage of this plate for lathe work. It should be noted that the bottom of this angle-plate should be made thicker than the ordinary type so as to secure proper rigidity.

C. R. BARTON

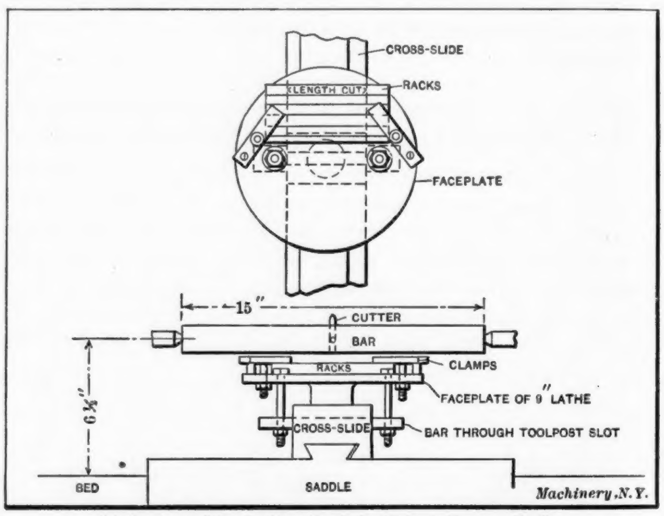
Elizabeth, N. J.

CUTTING RACKS IN A LATHE

In small jobbing shops it is sometimes necessary to do work which is quite a problem on account of the meager equipment. This was the case with six racks which we had to cut. These were made from 1/2-inch square brass 6 inches long. The teeth were to be cut to within 1 inch of each end, making the total length of cutting 4 inches. The diametral pitch was 28 so that the circular pitch was 0.1122 inch, the depth of the teeth was 0.077 inch, and the thickness of the cutting tool at the point 0.0375 inch. To cut the teeth in the rack the six pieces of brass were soldered together to form a unit. This made a block 6 by 3 by 1/2 inch.

The only two machines available to perform the job on were a 9- and a 13-inch Barnes lathe. So the faceplate of the smaller lathe was bolted onto the top face of the tool-slide of the larger lathe, as shown in the accompanying illustration. This was accomplished by putting a bar through the slot in the toolpost slide, and then strapping the faceplate onto the slide, by two clamping bolts as shown. The racks were fastened onto the faceplate by means of two clamps.

The bar which was used to hold the cutter was made of a piece of 1 1/4-inch shafting with a 3/8-inch hole near the center to hold the cutter, which was fastened by a headless set-screw. The cutter was made from a piece of 3/8-inch drill rod, turned up as close to the bar as possible. It was turned



Method used in Cutting Rack in 13-inch Barnes Lathe

to an included angle of 29 degrees and made 0.0375 inch wide at the point. The extending of the cutter from the bar to give the correct depth of cut also provided for relief.

The lead-screw of the lathe had a lead of 1/8 inch, so that by using a 20-tooth gear on it, and moving it 18 teeth for each spacing, the saddle was moved $\frac{18}{20}$ of 0.125, which is 0.1125 inch, thus giving an error for each tooth of 0.0003 inch which was close enough for the job.

After the racks were cut they were detached by heating them to melt the solder, when they were found to be all that could be desired.

JACK FINLAY

Hartford, Conn.

ABUSE OF THE THREE-JAW UNIVERSAL CHUCK

The three-jaw universal chuck properly fitted to a lathe spindle is one of the most economical appliances in the machine shop. "Yes, if it's new," some will say when they have read thus far. The makers of these chucks do not make an extension for the handle of the wrench about 12 inches or so long or one would be included when you purchase a chuck. The scroll is made to stand so much pressure and no more, and at the same time retain its accuracy. What good is a chuck of this kind if it is not accurate within a certain degree? Usually a shop has a chuck for a little while that will pass, but when a "fat head" comes along who doesn't care and, having it in charge for a period of "one job," puts a pipe on it for a larger leverage,

he strains the chuck at that point. If the job requires so much of a hold that it necessitates the aid of a pipe, that job requires a larger chuck. If the foremen of the shops would forbid the use of pipes on all universal chucks installed, they would be more in demand. They are made to run true and will if properly cared for. JOHN HOMEWOOD

Chicago, Ill.

A MULTIPLE MILLING FIXTURE

Castings similar to the one shown in Fig. 1 are used on almost all classes of machine work. The one shown here is the tail-end lead-screw support for a 14-inch engine lathe. The face marked *f* on this casting is required to be finished, and to do this the multiple fixture shown in Fig. 2 was designed.

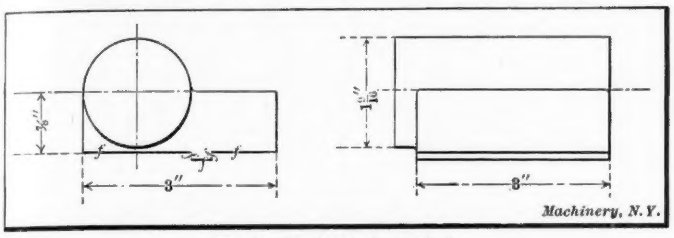


Fig. 1. Casting to be milled

From a study of Fig. 1, it can be seen that this piece is very difficult to hold, as it has no bosses, lugs or cored holes by which to clamp it, thus making it a very awkward proposition. On the work of this description it is also necessary to provide means so that the work can be set quickly and accurately, and also held so that it can withstand the cut especially at the start.

The fixture *A*, shown in Fig. 2, is of very simple design and is made of cast iron. The bosses *B* and *C* are cast integral with it. The bosses *B* have V-grooves cut in them, in which the spherical part of the castings rests. The bosses *C* are drilled to fit the cup-shaped supports *D*, which are made from second grade steel, the face being hardened, and the shank being left soft. The faces of these supports are cut out at an angle of 45 degrees, the upper half of the face being partly cut away to clear the milling cutters. A hole for a taper pin *a* is drilled, partly in the bosses *C* and partly in the stops or supports *D* to prevent the supports *D* from turning, as it is obvious, when tightening the clamping screw *E*, that a certain twisting movement will be given to the support *D*. All the other parts of this fixture are clearly shown, so that it will not be necessary to describe them further. It may be well to mention, however, that a hardened tool-gage *M* is clamped to the left end of this fixture for setting the milling cutters.

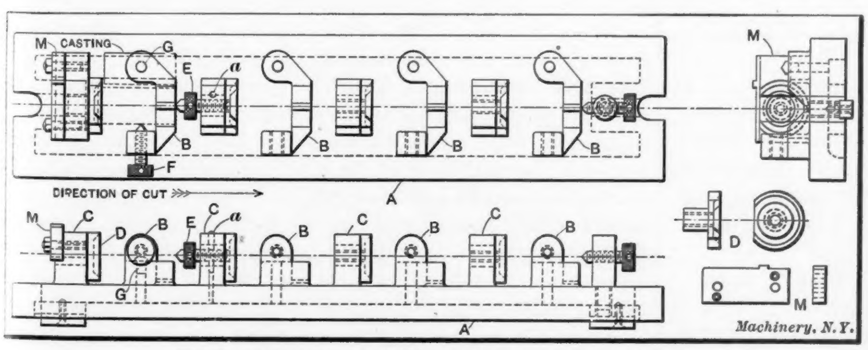


Fig. 2. Fixture used in Milling the Casting shown in Fig. 1

In operating this fixture the casting is set in the V-grooves cut in the bosses *B*, and forced into the cup-shaped hole in the stop *D* by screw *E*. While tightening this screw the casting should be held down with the hand to prevent it from rising. After this screw has been tightened the screw *F* is tightened, which is located above the center and holds the casting down on the cone-pointed pin *G*. Sufficient pressure is given to all these screws so that their points are embedded in the casting, and thus hold it very firmly. By forcing the boss of the casting into the stop or support *D*, it is centered and securely held, preventing it from rising at the starting of cut.

After four castings are set in the fixture and the cutters have been set to the master-plate *M*, the machine is started, and after finishing the first casting the table is moved across the intervening space between it and the next by hand. Then the feed is again thrown in and the second casting completed. While the second casting is being completed, the first one can be taken out and replaced and when the fourth casting is finished the table is lowered and run back. Then while finishing the first casting, the fourth one can be taken out and replaced, thus making the operation practically a continuous one. On an average, about eleven minutes is required to finish four of these castings. WILLIAM H. VOCKELL

Cincinnati, Ohio.

A NOVEL SPRING WINDER

The accompanying illustration, Fig. 1, shows a cheap and efficient spring winder for making spiral springs, which has been in use by a large automobile concern for some time and has proved to be very satisfactory.

The device consists of a casting having a flange *D* which may be fastened to the work bench by a clamping bolt *E* and two lugs *C* provided with V shaped slots in their narrow ends to receive different sizes of mandrels. The two eye-bolts *B* hold the mandrel in position; the holes in these eye bolts should be of the same diameter as the size of the largest mandrel that it is desired to use. The crank *F* has a triangular

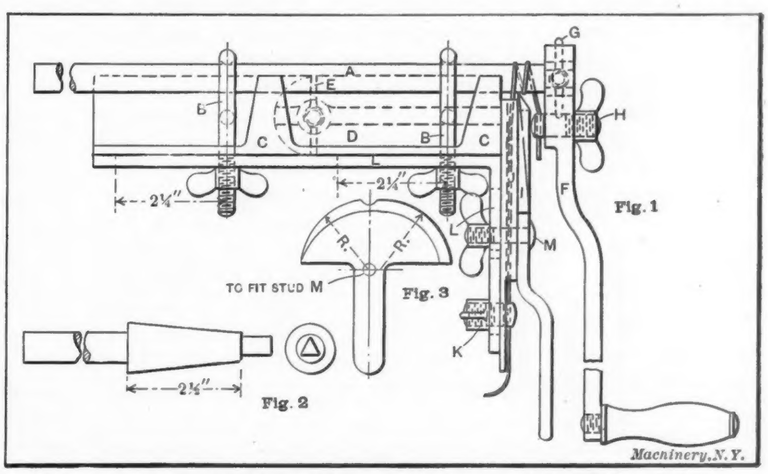


Fig. 1. Plan View of Spring Winder. Fig. 2. Arbor used for Winding Conical Springs. Fig. 3. Spacer used for Winding Conical Springs

hole of a size sufficient to take in the largest mandrel, and a thumbscrew *G* to clamp it fast to the mandrel, also a bolt with a wingnut *H*, the bolt having a hole in the end to receive the largest wire that is to be wound. The guide *J* for the wire has a hole through its entire length of the same diameter as the hole in the bolt *H*. The spacer *I* is made of a thickness equal to the greatest pitch of spring that it is desired to wind. The edge which presses against the arbor *A* is beveled as shown, thus giving a guiding surface from nothing to the full thickness of the spacer at the center.

The guide *J* and the spacer *I* are both mounted, as shown, on the bracket *L*, being held in position by a bolt *M* with a wing-nut. The hole for this bolt is elongated in *L* to allow adjustment of the guide and spacer for different sized mandrels. A bolt with a wing-nut similar to the one at *H* is shown at *K*, the hole for which is also elongated in *L*. This bolt provides means for securing the desired amount of tension on the wire while winding.

In operation the wire is passed through the hole in the bolt *K* and the hole in the guide *J*, then bent around the arbor *A* and inserted in the hole in the bolt *H* and there secured. The spacer is then adjusted for the desired pitch by rotating it on the pivot until the distance from the hole in *J* to the guiding edge of the spacer is equal to the pitch wanted. *J* and *I* are then adjusted so that the edge of the spacer just clears the mandrel and it is then clamped fast. *K* is adjusted for

the required tension and then it is only necessary to turn the crank to get the desired spring.

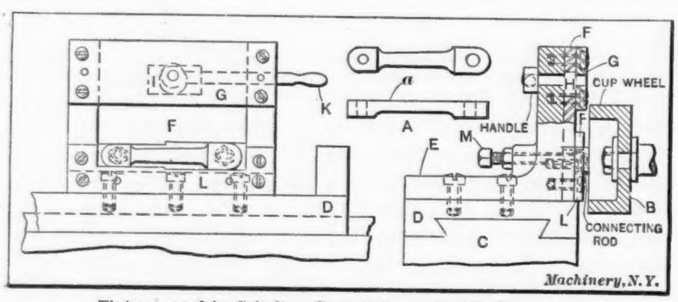
Conical springs may also be wound with this device by making a special mandrel as shown in Fig. 2 of the same taper as the required springs. The small end of this tapered portion should be next to the crank. To provide for the proper contact of the spacer with the mandrel while winding conical springs, the lower edge of the spacer is made radial from a point at one side of the pivot, as shown in Fig. 3. The distance that this point is off from the center should be equal to one-half the difference between the large and small diameters of the mandrel. The bracket *L* is slotted for the eye-bolts sufficiently to allow the guide and spacer to be extended an amount equal to the length of the conical spring desired. The fixture here shown will wind a spring 2¼ inches long.

In operation for conical springs the bracket *L* is pulled out 2¼ inches, and the spacer adjusted so that its lower edge or largest diameter comes in contact with the mandrel at the small end. The bolt on which the spacer rotates is then adjusted so that the spacer may be rotated, the wire is placed the same as for spiral springs and the crank turned with one hand while the spacer is kept in contact with the mandrel with the other, which is done by simply exerting a slight upward pressure on the handle. C. G.

A USE FOR "CUP" GRINDING WHEELS

The accompanying illustration shows a novel method of grinding the face of connecting-rods by means of a cup-wheel. *A* is the connecting-rod, which is faced off on the flat side *a*, and *B* is the grinding wheel, shown in section.

The fixture consists of a bed *C* with ways on which is mounted the slide *D* provided with suitable gibs. The slide *D* has an angle-iron *E* secured to it by screws as shown. The vertical face of the angle-iron is grooved to receive the slide *F* which is held in by the plate *G*, screwed onto the vertical face of the angle-iron. The slide is moved up and down by means of an eccentric *H* which works in a recess *I* in the slide, and is operated by a handle *K*. A crank is shown in position ready to be ground, and is clamped in between the bottom of the slide *F* and a plate *L* which is fastened below it to the angle-iron *E*. Set-screws *M* act as stops on the unfinished



Fixture used in Grinding Connecting-rod with Cup-wheel

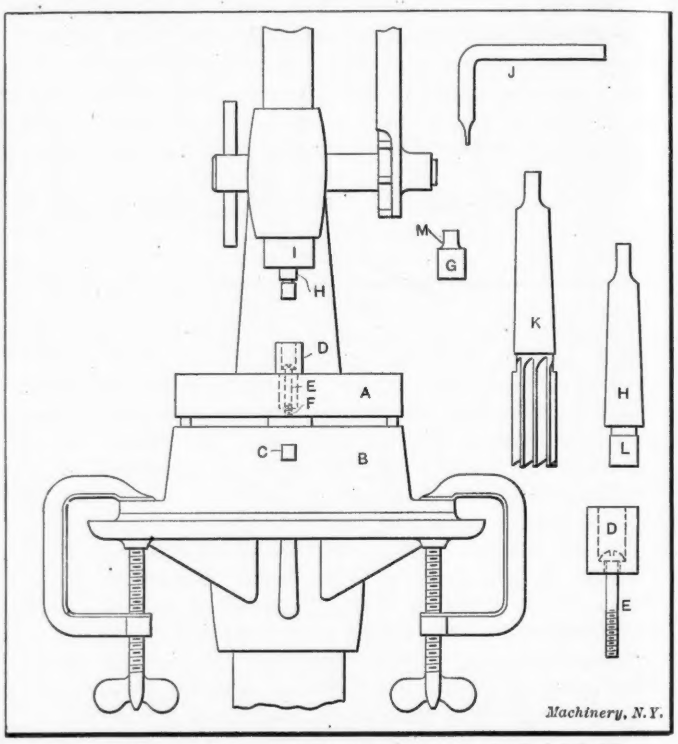
side of the connecting-rod and are adjusted as desired. A screw and hand-wheel, which are not shown, serve to feed the work to the cup-wheel. The connecting-rods after being ground are so hot that it is necessary to remove them from the fixture with a pair of tongs. After being cooled a hole is drilled in each end as shown, and they are then faced off on the side opposite to *a* in the ordinary way.

C. D. K.

LOCATING PUNCHES IN THE PUNCH-HOLDER

The accompanying illustration shows a simple method of locating round, piercing punches in the punch-holder, which has proved very satisfactory to us since it has been in use. The holes for the punches can be located, drilled and reamed very quickly, and if reasonable care is taken in setting, the work will be sufficiently accurate for ordinary conditions. This method is used when punches are secured in the punch-holder by set-screws.

Referring to the illustration, *A* is the punch-holder and *B* is a holder made of cast iron, carefully machined top and bottom, and bored to fit the shank of the punch-holder, which is fastened in it by the set-screw *C*, the punch-holder resting on parallels. *D* is a locating button hardened and ground, having a ½-inch hole in the upper part and a ¼-inch hole in the lower part. The ½-inch hole should be ground straight and true and with its axis at right angles to the bottom of the button. *H* is a pilot made of tool steel hardened and ground, with a Morse taper shank to fit the spindle of the drill press and has a portion *L* which is made a good sliding fit in button *D*. *G* is a plug made to fit snugly in the button *D* and has a portion *M*, which is the same size as the body of the punch; it is also made to fit snugly in the templet. These plugs are made in a large variety of standard sizes and form a per-



A Simple Method of Locating Piercing Punches in the Punch-holder

manent part of the outfit. The reamer or end-mill *K* is made with a Morse taper shank and is ground so that it will ream a hole which shall be a drive fit for the shank of the punch.

To lay out the holes in the punch-holder for the punches, proceed in the following manner: Lay out the various holes from the templet which was used in laying out the die, and drill holes 1/32 inch smaller in diameter than the shank of the punch, to the depth that the punch is to be set in the punch-holder. Then the small hole shown at *F* is drilled and tapped for a 10 by 32 button-head machine screw. The first punch hole is now reamed with the reamer *K* and the punch is driven in place. The button *D* is then held in place with a screw *E* over the next hole in the punch-holder, the plug *G* placed in the button *D*, and with the templet in place on the first punch, the button *D* is located for the second hole and securely held in place by the screw *E*. The pilot *H* is now placed in the spindle *I* of the drill press and the punch-holder located on the table, so that pilot *H* enters the button *D*. The holder is then held in place by the C-clamps shown, the button *D* removed by means of the bent screw-driver *J*, which is made from ¼-inch round steel, the pilot *H* removed and the reamer *K* placed in the spindle *M* of the drill press, when the hole can be reamed to size; the same procedure is followed for all the punches.

In using this method it is, of course, necessary to see that the spindle of the drill press is carefully adjusted, and that the table lines up properly with it. This same method could also be used on the milling machine.

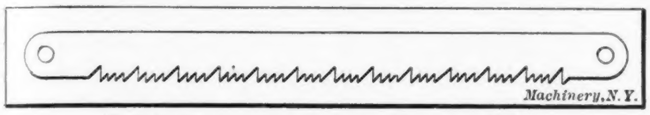
Aurora, Ill. E. J. G. Phillips

UTILIZING OLD HACK-SAW BLADES

It may seem trifling to talk about saving a hack-saw blade, but when a large number are used the cost soon mounts up; and in some cases when we get into a tight corner, we like to

make a hack-saw blade last as long as possible. It has impressed the writer many times that there should be some way to lengthen the life of the common hack-saw blade, so that when the sharp cutting points are removed from the teeth it will not have to be discarded. The teeth may sometimes appear to be in fairly good shape, but a trial of their cutting properties will soon show that they have reached the end of their usefulness. To illustrate my point, permit me to cite an instance. One day while using a saw in just the condition mentioned, and being without another at the time to take its place, the thought came to my mind that it might be possible for me to improve its cutting. The idea was this. I took the saw to an emery wheel held it against the corner and ground a number of coarse teeth along its length a little deeper than the regular teeth, as shown in the accompanying illustration. This seemed to give satisfactory results and bit into the metal in fairly good style.

Another instance also comes to my mind of a makeshift which I have practiced with a tempered hack-saw blade (the



Method of Increasing the Life of Hack-saw Blades

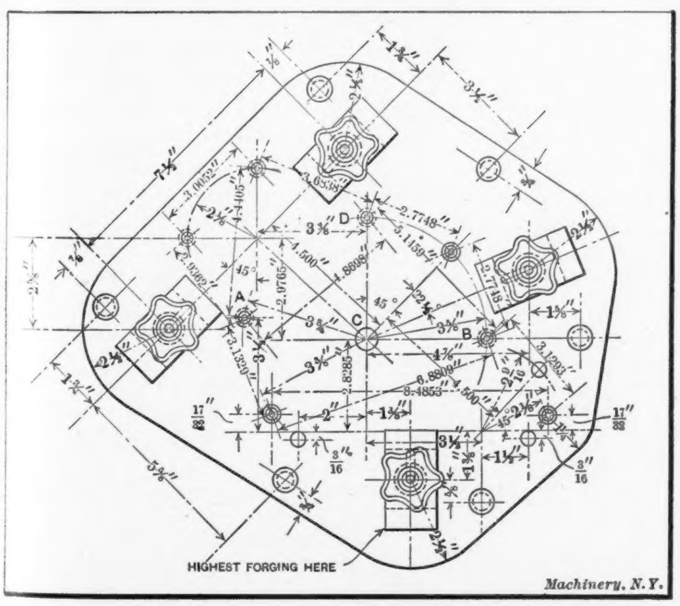
harder, the better). Break off the old saw or use a piece already broken off in service, and use this for a glass cutter. For this purpose the corner should be ground off slightly and to a knife edge. If this is done it will be found to cut glass satisfactorily until it is dull, when it can be quickly sharpened as before.

Another use to which I frequently put worn-out hack-saw blades, is for small washers. To do this anneal them by heating the ends to a cherry red and bury them in ashes. When cool and soft, cut off the ends with a chisel, grind and file around the hole and you have a small washer for many purposes. Of course, this is not suggested as an economical way to make washers, but as a trick to supply a want which is sometimes urgent. C. S. Bourne

Lowell, Mass.

PRACTICAL METHOD OF DIMENSIONING JIGS AND FIXTURES

As regards the article entitled "Improved Method of Dimensioning Jigs and Fixtures," by "Jig and Tool Designer,"



Practical Method of Dimensioning Drawings for Jigs and Fixtures

which appeared in the October number of Machinery, it is my opinion that Fig. 2 shows a more correct method of dimensioning than Fig. 1, but even that lacks many of the dimensions required by the toolmaker for spacing the holes accurately.

By using the dimensions shown in the accompanying illustration, the holes in this jig can be bored very accurately in the lathe or on the milling machine, and can be easily checked as to their relative distances from each other. I have found by experience, and I think many toolmakers will agree with me, that laying off accurate distances with the use of the micrometer dial on the milling machine is almost an impossibility, owing, no doubt, to the fact that the screw to which the micrometer dial is attached soon becomes worn, and therefore useless for setting the milling machine to very accurate distances.

Let us assume that the holes for the bushing are to be bored in the lathe, in which case they would be located by buttons. With the dimensions given in the illustration, the toolmaker can readily locate the hole *D*, while with the dimensions given in Fig. 1, or the so-called "correct method," I fail to see how a toolmaker could locate hole *D*, unless the cross dimensions referred to above were given to him.

Again, suppose these bushing holes are to be bored on a milling machine. In this case the toolmaker would first lay them out to the dimensions given as closely as possible and then drill the holes about 1/16 inch smaller than the finished size, after which he would proceed to strap the fixture in an upright position on the milling machine, and bore the hole *C* to some convenient diameter. He then would bore the hole *B* to the correct dimension, after which he would bore the hole *A*. The next step would be to lower the milling machine table and bore the hole *D* slightly smaller than the finished size. By inserting plugs in all of the holes he would proceed to check up the hole *D* with a micrometer caliper or vernier, and find its correct location, or relative position to the other holes. When the exact center is found he would finish bore the hole. The remaining holes would also be located and bored in a similar manner. Edw. Merz

Buffalo, N. Y.

PREVENTING A PENCIL POINT FROM BREAKING

The accompanying illustration shows a simple way to prevent, or lessen the chance of breaking the point of a pencil when it falls. One end of the pencil is cut circular as shown

Simple Method of Preventing a Pencil Point from Breaking

to the size of the internal diameter of a small piece of steel tubing, *A*, about 3/4-inch long. The tubing is then forced into the prepared end, making the pencil heavier at this end than at the other. Naturally the heavy end hits the floor first, thus eliminating the chance of breaking the point.

Manchester, England. W. Thompson

THE PROCRASTINATOR

There lived a man with imagination,
Who planned to startle all creation.
Each day he talked us all near dead
And this is what the braggart said:
"When I'm an old, discarded tool,
With naught to do but sit and fool,
When my dear friends have passed away,
And auburn locks are streaked with gray,
I time will find and inclination
To start a wondrous cerebration.
You say: 'Hot air!'—but no one knows;
Before I turn my stiffening toes
Towards the sky and die content,
I may, on blissful labor bent,
Dig up some truths ne'er heard before,
Invent and patent schemes galore.
The things I long have had in mind
You on the market then will find.
My gearless, beltless, shaftless drives,
Appliances to save men's lives;
My wheelless, frameless, noiseless tools,
And cardless systems, brains for fools.
Yes, I'll make them all look sick
When I find time to turn my trick!"
Thus raved he till the whistle blew;
At home he dreamed that dreams come true;
He boasted, waited, schemed and cussed;
His thinking-box grew thick with rust.
He now is old. Vain, thoughts of fame!
And who, pray, can the duffer blame?
A scheme is N. G., not worked out;
It does not pay to simply shout.
To wait brings never fortune big;
The only recipe is—DIG.

Philadelphia, Pa. John S. Myers

HOW AND WHY

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST

Give details and name and address The latter are for our own convenience and will not be published.

"PITCHING THE PIVOTS" IN WEIGH LEVERS

M. S. T.—What is the object of "pitching the pivots" in large weigh scale levers?

A.—"Pitching the pivots" in a weigh lever is setting the load pivot so that its edge will be slightly above the other two pivots. The object is to overcome the effect of deflection of the lever so that when the scale is fully loaded the pivot edges will be in line. Sometimes additional allowance is made for wear so that the pivots may be sharpened without drawing them out of line. Too much pitch makes the balance unstable, and difficulty will be found in setting the poise at a point where the beam will remain horizontal, the tendency being to indicate "up" or "down" weight.

MOUNTING BLUEPRINTS

J. B. & Co.—We would like some information concerning the mounting of blueprints for use in a machine shop. At present when we have made the blueprints we mount them on galvanized iron sheets, which we accomplish by the use of pure white gum shellac varnish. When the prints are thoroughly set to the face of the tins we clinch the edges of the sheets over and give the prints a couple of coats of white shellac varnish. We have a few objections to this method and would ask if you could suggest something better. Our objections are: 1. The cost of the galvanized sheets. 2. The trouble necessary to get the prints to adhere firmly. 3. The inconvenience of making alterations on the prints. 4. The difficulty in removing the blueprint when it is no longer of use. 5. When we use the sheets a second time we find the portion of the sheet lapped over on the first occasion, will not stand further bending without breaking off and leaving ragged edges.

A.—Strawboard of appropriate thickness is largely used for mounting blueprints for use in the shop. Suggestions from readers in reply to the above will be appreciated.

CUTTING AN ABNORMAL BEVEL GEAR

E. T. L.—I have a pair of beve gears such as shown at *A* and *B* in Fig. 1. The teeth are 2-inch circular pitch. Gear *A* has 37 teeth and pinion *B*, 14 teeth. This gearing transmits 25 HP with the pinion running at about 400 R. P. M. I desire to run another pinion, *C*, with gear *A* on a shaft set at an angle of 79 degrees, as shown. The peculiarity of the case is that

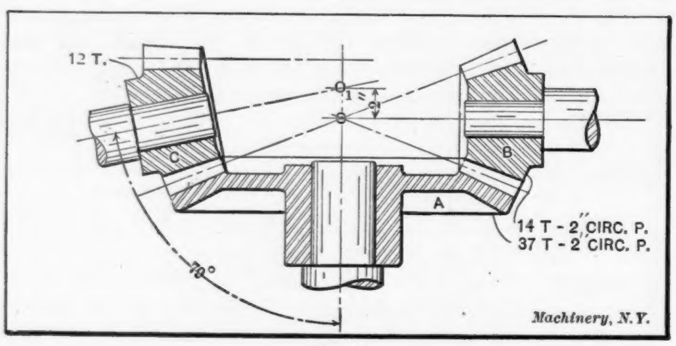


Fig. 1

the center line of the shaft on which pinion *C* is mounted, does not pass through apex *O* of gears *A* and *B*, but through a new apex, O_1, 2 inches further out. Can such a pinion as *C* be cut? It is required to transmit 5 HP to *B*.

Answered by Ralph E. Flanders, Springfield, Vt.

A.—It is theoretically possible to cut the kind of a gear shown at *C* in Fig. 1, if the teeth are generated on a bevel gear planer, and if the center line of the pinion shaft is not too far away from the apex of the gear. The conditions under which such gears operate are shown in Fig. 2. At *A* and *B* on the right of the engraving are shown the normal pitch cones of the gear and of the normal pinion. At the left of the engraving are shown the abnormal pitch cones of the gear and of the abnormal pinion. It will be seen that large gear *A* has two different pitch cones, one for the normal and the other for the abnormal gear. Gears of involute form, or of the corresponding form applied to bevel gearing, have this possibility of changing the location of the pitch line without affecting the running of the tooth. The difficulty in your case is that you demand an extreme condition. It will be seen at the left of Fig. 2 that the pitch line of pinion *C* at the small end of the tooth is entirely inside the tooth, and so is entirely outside the tooth of gear *A*. The chances are that for any ordinary width

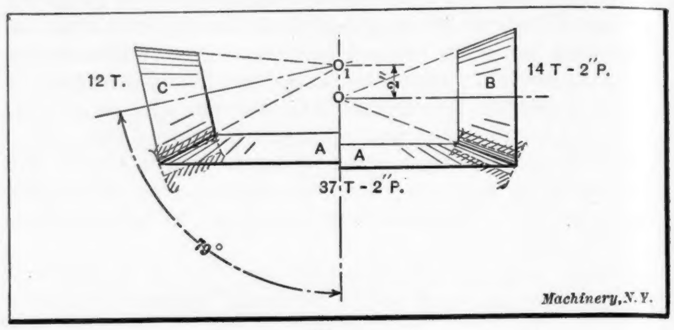


Fig. 2

of face for gear *C*, the tops of the teeth would come to a sharp edge before they reached the small end. Fig. 3 shows the method of cutting these gears. With the normal gear, the movement of the tool, the rolling of the blank, etc., all center on point *O*, where the tooth disappears, this point being located on the center line of the blank at the apex of the pitch cone. In the case of the abnormal gear, on the contrary, this

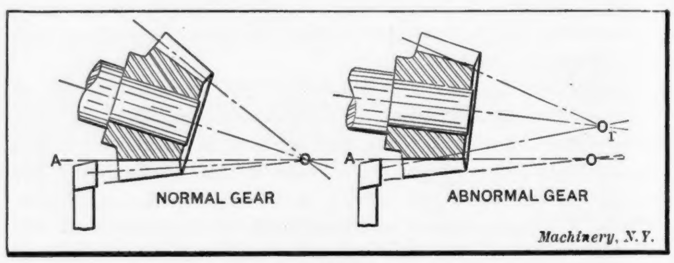


Fig. 3

point *O*, toward which the tool travels, is 2 inches away from the apex O_1 of the pitch cone of the abnormal gear.

Mr. Hugo Bilgram, 1233 Spring Garden St., Philadelphia, Pa., has cut abnormal gears of this type on his bevel gear generating machine; in fact, he exhibited a set of such gears seventeen years ago at the World's Fair in Chicago. He would be able to furnish you a pinion such as you desire, if it is a possible thing to make it.

So far as the horsepower is concerned, any gear *C* which could be cut at all, and have correct action, would transmit 5 H.P. if gear *A* is transmitting 25 H.P.

* * *

At the recent convention of the British Medical Association an interesting paper was read on the subject of electric shocks. It has been noted that deaths have occurred due to shocks from 100-volt currents, while at other times a 1000-volt circuit has failed to kill. It was pointed out that aside from voltage, the amperage and the character of the current, whether direct or alternating, the duration of the shock, and its point of application, must be considered. The resistance of the skin has much to do with the matter, and the effect on one individual may differ greatly from that on another. The condition of the mind is also of importance, for a person who is prepared to receive a shock is less liable to be affected by it than one who receives it unexpectedly and accidentally.

* * *

It was stated by Mr. F. J. Kean in a paper read before the Institute of Marine Engineers that as the result of extended experiments with an 8½ by 14-inch single-cylinder oil engine, running at 250 revolutions per minute, the following conclusions had been drawn: Economy in oil consumption is greater with moderately high compression than with a very low compression before ignition; a very hot vaporizer is conducive to greater economy than one only moderately hot; injecting water with the oil vapor, damps down the total combustion and, hence, lowers the economy.

NEW MACHINERY AND TOOLS

A MONTHLY RECORD OF APPLIANCES FOR THE MACHINE SHOP

Comprising the description and illustration of new designs and improvements in American metal-working machinery and tools, published without expense to the manufacturer, and forming the most complete record of new tool developments for the previous month

VAN NORMAN NO. 3 DUPLEX MILLING MACHINE

The Waltham Watch Tool Co., Springfield, Mass., has placed on the market the No. 3 Van Norman duplex milling machine shown in Fig. 1. The special feature embodied in the construction of this machine that distinguishes it from other types of milling machines, is the movable cutter head, which is mounted on a ram or frame that may be adjusted in or out over the table to adapt the cutter for use in either a vertical or horizontal position, the cutter spindle being adjustable to any angle from the horizontal to the vertical. Among the features incorporated in the design of the No. 3 size which are not found in the sizes formerly built, may be mentioned the single pulley or constant speed drive with a change gear mechanism for varying the spindle speeds, located in the ram; a geared feeding mechanism; an improved box type of knee; and a solid steel overhanging arm, with braces to give rigidity for either vertical or horizontal cuts.

This machine is solidly constructed throughout and it has ample power for both spindle drive and feed mechanism. The details of the drive and the spindle change gear mechanism are seen in the sectional views, Figs. 2 and 3. The driving pulley A, Fig. 2, is mounted on a splined shaft a, which is supported in a bracket B, attached to the side of the machine column, as shown in Fig. 1. By means of a pair of bevel gears C and D, the driving shaft is connected with shaft b within the ram, on which is mounted the loose clutch gear E and the combined sliding gear and clutch F, which is keyed to the shaft. These gears engage with gears G and H, which are keyed together and revolve on a stationary stud or shaft c, and the drive is through gear E or F, depending on the position of the latter, which is controlled by the lever P, Fig. 3. A swinging frame or yoke Y, pivoted on shaft c, has a stud d which carries a sliding gear I that is in mesh with the long gear G. This tumbler gear I may be brought into mesh with any one of a cone of gears J, K and L, which are keyed together, and mounted on the stud or shaft e.

The swinging frame Y, carrying the sliding tumbler gear I, has at its upper end (see Fig. 3) a spring-pin mechanism to locate it in the different positions, and also a lever Q to securely lock and clamp it in place. An index lever R, operating through a pinion r_1 that engages a rack on the sliding forked piece r_2, locates the sliding gear I for suitable engagement with cone gears J, K and L. Loose clutch gears M and O on shaft f mesh with the cone gears J and L, and one or the other of these gears may be connected to shaft f by the clutch N, the position of which is controlled by lever S, Fig. 3. Thus it will be seen that shafts b and f revolve, while the studs c, d and e are stationary and carry free-running gears. By means of this mechanism twelve changes of spindle speeds, varying from 15 to 276 revolutions per minute, may be obtained, the speed changes being effected by operating the sliding gears F and I and the clutch N. All the gears are of steel, and those within the ram run in an oil bath. A handwheel on the end of shaft f may be used to facilitate bringing the gears into mesh when making changes.

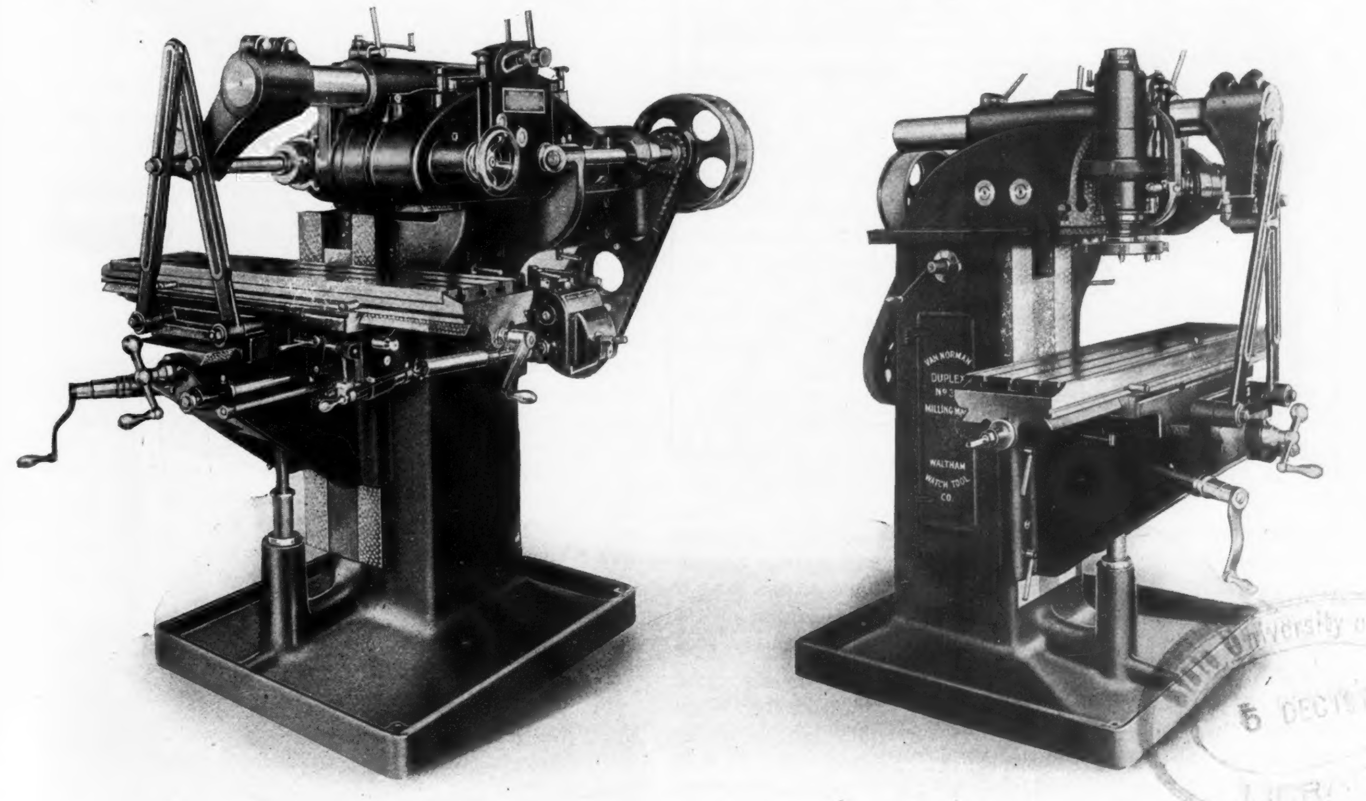
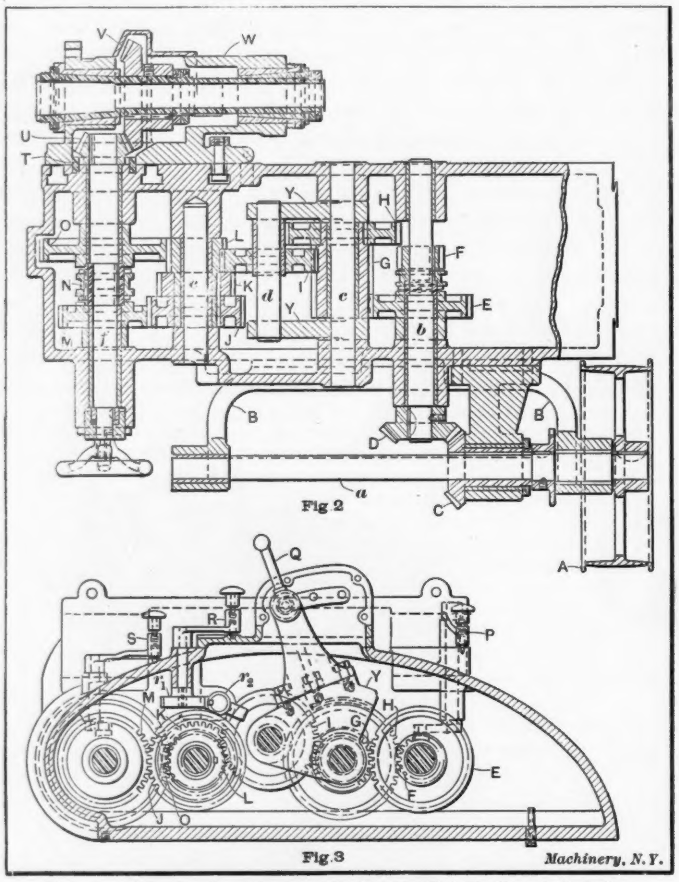


Fig. 1. Two Views of the Van Norman No. 3 Duplex Milling Machine

The cutter-head W, which has a 90 degree angular adjustment, pivots on the trunnion ring T. The head is securely clamped on the face of the ram by three locking bolts which move in circular T slots. A bevel gear U on the end of shaft f, and a bevel gear V on the spindle, complete the drive connection. The cutter spindle has the conical form of bearings, and is made with a No. 13 B. & S. taper, to adapt it for holding the large collet holder or reducing collets that are used in this machine. The ram may be securely clamped to the column by means of two binder levers, after the cutter spindle is located in the most advantageous position for operation. This ram has a 13-inch movement in and out over the column, and the adjustment is effected by means of the crank shown near the top of the column to the right in Fig. 1. The length of the ram is 35 inches and the width 11½ inches. The driving pul-

ley is 12 inches in diameter, with a 4¼-inch face, and should be run at a constant speed of 300 revolutions per minute.

The feed change mechanism gives sixteen changes of feed, ranging from 7/16 inch to 13 inches feed of the table per minute. The drive to the feed-box is by a chain which connects with the main driving shaft. The table, which has a working surface of 45 by 10 inches, has a longitudinal feed of 30 inches, a transverse feed of 12 inches, and a vertical feed of 19 inches. The knee also has a vertical movement of 19 inches. The



Figs. 2 and 3. Sectional Views showing the Spindle Speed-changing Mechanism

countershaft furnished with the machine has pulleys 13 inches in diameter and 4½-inch face, for forward and reverse speeds. The swivel vise, also included in the equipment, has jaws 7 inches wide, 1½ inch deep, with a maximum opening of 4½ inches. The weight of this machine is approximately 4000 pounds.

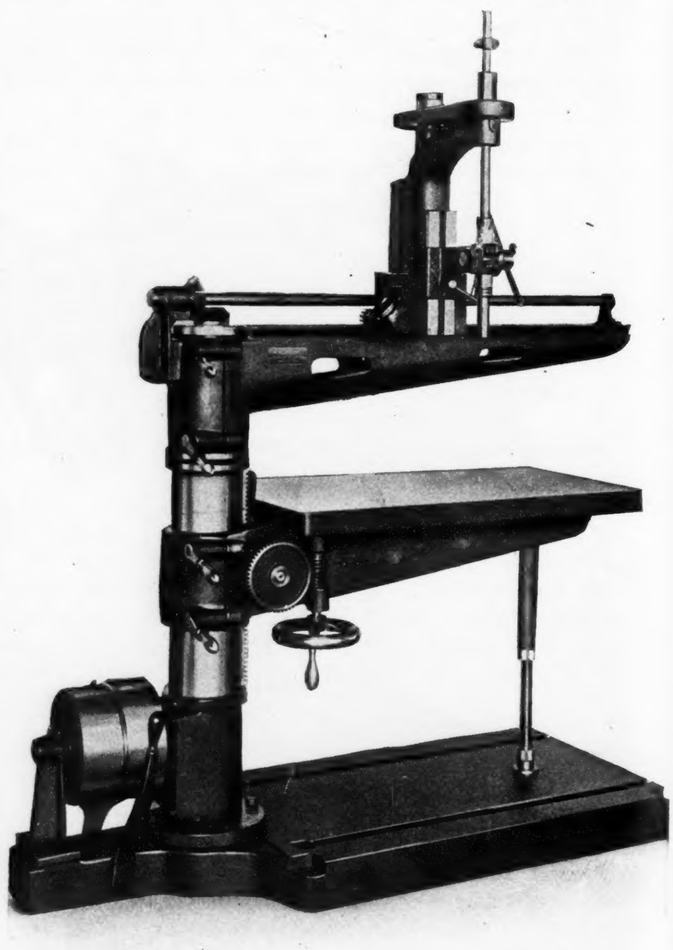
The equipment regularly furnished consists of a draw-in spindle for holding large taper-shank mill mounts or arbors; one ⅞-inch split collet; one reducing collet with No. 7 B. & S. taper hole; one 2¾-inch end-mill; one cutter arbor; one vise; a set of wrenches and countershaft. There also can be furnished extra, if desired, semi-universal or full universal centers and sub-head, and also a slotting attachment.

TAYLOR & FENN RADIAL DRILLING MACHINE

The radial drilling machine illustrated herewith is a design that has recently been added to the line of drilling machinery built by the Taylor & Fenn Co., Hartford, Conn. This drill press contains all of the principal features of the standard line built by this company, with the addition of a greatly increased capacity. By the adjustment of the head and the radial arm, holes may be drilled in pieces that are too long or too heavy to be conveniently handled on the company's other types of machines.

This drill press is designed for drilling holes up to ¾ inch in diameter, and by the application of drilling heads of different types it can be made to cover a wide range of drilling requirements. An automatic power feed, lever feed, high-speed sensitive or tapping heads may be used on this machine, either singly or in combination. The drilling head is mounted on dovetailed ways on the arm along which it is adjusted by means of a rack and pinion. A binder at the rear provides means for clamping the head to the arm. The spindle is positively driven by a silent chain, and the gear box on the back of the drilling head gives three spindle speed changes. The arm is tubular in section, and has an exceptionally long bearing on the column supported by a ball thrust collet. The table is heavily ribbed and, in addition, is provided with a support for the outer end that may be used when heavy work is mounted on it. Both the arm and table may be clamped to the column by the binder screws shown, the handles of which are conveniently located.

This machine is driven by tight and loose pulleys at the rear of the column and does not require a countershaft. The principal dimensions are as follows: Length from the center of the column to the end of the arm, 42½ inches; maximum distance from the center of the spindle to the column, 36 inches, and the minimum distance, 11 inches; maximum distance from the end of the spindle to the base, 48 inches, and the minimum distance, 36 inches; maximum distance from the end of the



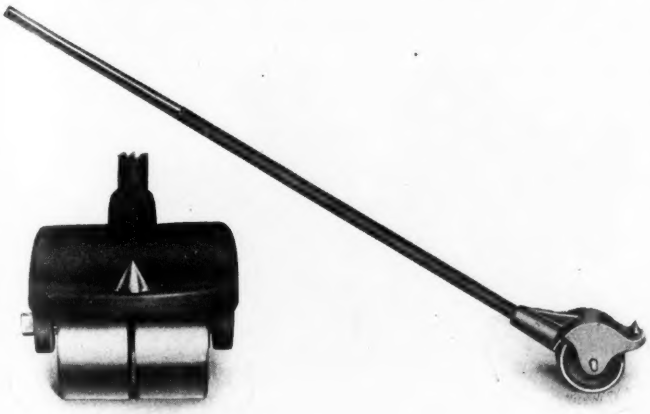
Radial Drilling Machine built by the Taylor & Fenn Co.

spindle to the table, 26 inches, and the minimum distance, 3¼ inches. The traverse of the spindle is 11 inches, and the length of feed, 4¼ inches. The size of the table is 20 by 35 inches, while the base is 24 by 36 inches. The over-all height of the machine with the spindle in its highest position is 79 inches. The floor space required is 2 by 5 feet. The width of the driving belt is 3 inches, and the speed of the driving pulley 310 revolutions per minute. The approximate net weight of this machine is 1070 pounds.

GROVER BAR TRUCK

A moving truck or crowbar, equipped with wheels to expedite the moving of heavy parts around a shop or in other places where heavy loads must constantly be handled, is shown in the accompanying engraving. On the end of the bar there is attached an enlarged head which furnishes a bearing for two wheels that move independently of each other. In the

nose of this head a conical point is inserted, as shown more clearly in the enlarged view to the left, which gives the bar a firm grip on the load. These trucks are sold in sets of three, and in use two are placed under one end of the load and the other under the opposite end, thus giving a support at three points. By bearing down on the levers or bars, the load is raised from the floor and is supported on the three sets of rolls or trucks, so that it can be easily moved in any desired direction. It is said that these trucks are capable of handling

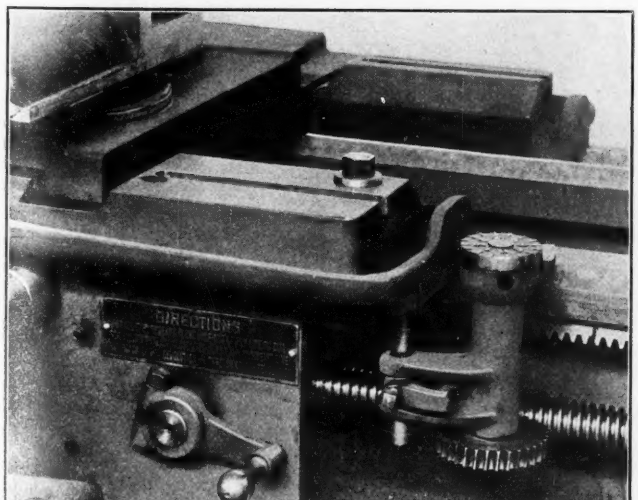


Moving Truck of the Bar Type

expeditiously pieces weighing three or four tons or under. They are easily manipulated and can be used effectively by any laborer. Even in modern plants equipped with traveling cranes, they doubtless could be used to advantage by relieving the cranes of considerable work. These bar trucks are manufactured by the Grover File Co., Nashua, N. H.

LODGE & SHIPLEY THREAD INDICATOR

The chasing dial or thread indicator, as most mechanics know, is a lathe attachment for thread cutting, which permits disengaging the half-nut at the end of each cut, running the carriage back by hand and re-engaging the half-nut at the proper point to "pick up" the thread, the tool following the previous cut. Running the carriage back by hand not only saves time, but also allows both countershaft driving pulleys to be run forward, thus giving the lathe twice as many forward speeds as would be obtained if one backing belt were used. Because of the foregoing reasons, the Lodge & Shipley

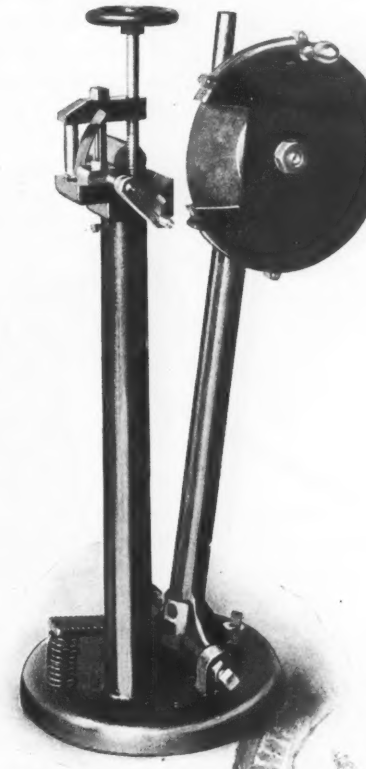


Lathe Carriage with Thread Indicator Attached

Machine Tool Co., Cincinnati, O., is now furnishing a thread indicator as a part of the regular equipment of every lathe. As shown in the accompanying illustration, this thread indicator, which has several novel features, is attached to the front arm of the carriage on the right side. The worm-wheel indicator is held lightly against the lead-screw by a coil spring and it can be swung back out of engagement when desired, or if a quantity of work which requires no threading is to be machined, the whole attachment can be quickly removed. Attached to the front of the apron close to the thread indicator, there is a brass instruction plate containing the following information: "Directions.—For all even threads close half-nut at any line on dial; for all odd threads close half-nut at any numbered line; ½ threads any ¼ revolution; ¼ threads any ½ revolution." Thus all the necessary instructions for using the attachment, briefly stated, are continually before the operator.

NUTTER & BARNES METAL-CUTTING MACHINE

The "elastic wheel" metal-cutting machine shown in the accompanying engraving is intended for cutting either bar stock or tubing and is surprisingly rapid in its operation. This machine has a capacity for tubing or piping up to 3 inches in diameter, and solid pieces up to ¾ inch in diameter, of either soft or hard steel. As the engraving shows, the machine is simple in construction, there being a base with a column for supporting the work and a swiveling arm carrying the cutting disk. This disk or wheel, which is 12 inches in diameter and 3/32 inch thick, should run at about 3000 revolutions per minute. As it requires no sharpening, the machine is always ready for use. It will be noted that the material to be cut remains stationary in the V work-shoe, the elastic wheel being swung forward to take the cut by either the right or left hand or the foot, there being, in addition to handles, a treadle at the base. This movement of the wheel instead of the work has a decided advantage, particularly when operating on long pieces which could only be fed to the wheel with difficulty. After taking its cut, the wheel is returned to its rest position by means of the spring shown inserted beneath the treadle. The V-block for supporting the work is equipped with a swinging gage, which is convenient when cutting duplicate lengths. Owing to the simplicity of construction, there are no parts on this machine to become deranged, and it is easily operated. It is manufactured by the Nutter & Barnes Co., Boston, Mass.



"Elastic Wheel" Metal-cutting Machine

FAN DYNAMOMETER FOR TESTING SLOW-RUNNING MOTORS

Heretofore, the fan dynamometer, when used for testing fast-running engines of the automobile type, has been connected, during the test, directly to the engine shaft. This method, however, has not been applicable to comparatively slow-speed gas engines of the stationary type, for the obvious reason that insufficient power would be absorbed by the fan, owing to its slow speed.

Mr. Joseph Tracy, 116 West 39th St., New York City, designer and builder of the dynamometer illustrated herewith, has found after a series of tests that the necessary increase in speed when testing comparatively slow-running motors may be obtained satisfactorily by belting the dynamom-

eter to the engine fly-wheel, as indicated in the illustration. Ordinarily the width of the fly-wheel is sufficient to permit the use of a belt that will transmit the required power, so that a special pulley is not necessary. This is a convenient and inexpensive method of testing stationary gas and other engines developing up to 100 horsepower at relatively slow speeds. As the dynamometer gives the best results when driven at a speed of 800 revolutions per minute or more, its pulley should, of course, be smaller in diameter than the engine fly-wheel.

This fan may also be used as a load to absorb the power when "running in" an engine, or working down the piston and bearings. As those familiar with the fan dynamometer know, it requires neither water nor electrical connections, the power delivered by the engine being absorbed in driving the fan against the atmospheric resistance. There is a tachometer attached directly to this dynamometer which has, in addition to the revolution per minute graduations, a set of six scales giving the horsepower for different positions of the fan blades, so that in operation the power being developed, less the transmission loss through the belt, is indicated directly by the pointer on the dial. To find the revolutions per minute of the engine, the revolutions per minute indicated by the tachometer are divided by the ratio between the pulley and the fly-wheel diameters. For example, if the tachometer indicates 1200 revolutions per minute and the dynamometer pulley is one-quarter the diameter of the fly-wheel, the latter will be making 300 revolutions per minute.

Fan Dynamometer driven by Belt from Flywheel when Testing Slow-running Motor

This application of a tachometer, giving both revolutions per minute and horsepower direct, is a distinct advantage over the type described in the January, 1906, number of MACHINERY, as the latter requires, in addition to a timepiece and revolution counter, a table of tests giving the horsepower for various speeds and positions of the vanes.

In the dynamometer as designed by Mr. Tracy the horsepower readings are calibrated by actual tests with an electric dynamometer. In these tests the fan dynamometer is driven by the electric dynamometer, in place of a gas motor, at various speeds covering the range of the fan dynamometer, and a power speed curve is obtained from which the tachometer is calibrated.

WALTHAM THREAD MILLING MACHINE

The accompanying illustrations, Figs. 1 and 2, show front and rear views, respectively, of a small thread milling machine which has been brought out by the Waltham Machine Works, Waltham, Mass. This machine is intended for work of smaller size and of greater precision than that which larger machines are, as a rule, designed to handle. Several features of design not found on other machines of this type have also been included. The machine is especially adapted for making taps of the smallest dimensions, for cutting micrometer screws, and for similar work. A detailed description is given in the following.

The headstock spindle is driven from a pulley by worm and worm-gear. The driving pulley is connected to the worm-shaft by a toothed clutch which is automatically disengaged upon the completion of the cut on the work. A handwheel is provided for turning the worm-spindle by hand when setting the cutters, etc. The spindle takes a regular lathe chuck, and has a ⅝-inch hole bored clear through it. Double, triple and quadruple threads can be cut by means of an indexing device attached to the spindle. The worm-shaft pulley has four steps. It is interchangeable with the driving pulley on the counter-shaft, and has a round driving belt which can run either on the next larger or the next smaller step than the one exactly in line with the step in the pulley above; hence, at least 16 changes of speed can be obtained for the headstock spindle.

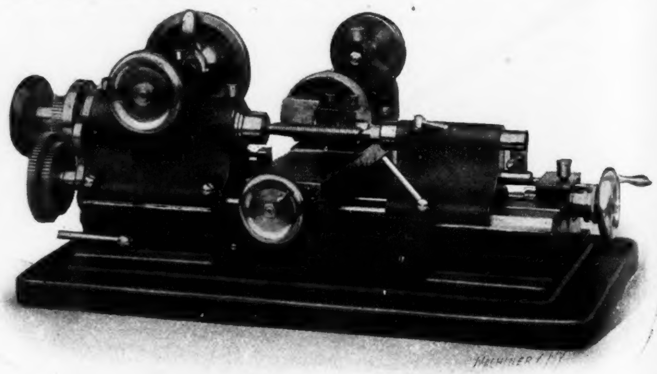


Fig. 1. Thread Milling Machine for Small Precision Work, made by the Waltham Machine Works, Waltham, Mass.

The movement of the spindle is transmitted to the lead-screw by means of a train of gears. Threads ranging from 10 to 80 per inch can be cut with the change gears regularly furnished. The machine can be arranged for cutting as coarse as 4 and as fine as 100 threads per inch if desired. The tailstock and its spindle are milled away very close to the center, so that the milling cutter can be brought near to the center line. Two tailstock spindles, one with a male and one with a female center, are provided.

The cutter used in the machine is 1½ inch in diameter and is mounted on a hardened spindle driven through a train of gears. The cutter head can be swiveled in a vertical plane around the center line of the cutter. It can also be swiveled in a horizontal plane. The graduations for the vertical swivel are on an arc of 4 inches diameter, and are in clear view on the top of the head. By using the horizontal swivel and a cutter of the proper angle, a buttress thread with one side square can be cut, and by reversing the work, and taking a second cut, a complete square thread can be obtained.

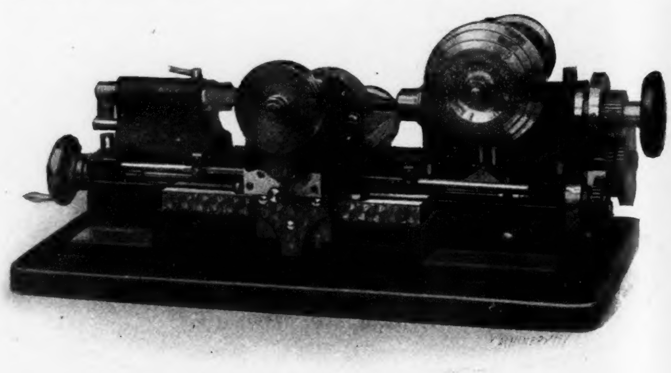


Fig. 2. Rear View of Thread Milling Machine for Small Work

The bearing of the cross-slide is 10 inches long and its feed-screw has a friction index with divisions reading to 0.0005 inch. A stop screw is provided as a safeguard against setting the cutter too deep when milling a number of pieces of the same dimensions. The nut for the feed-screw consists of a block which can be secured either to a part of the carriage or to the sliding bar of the taper attachment. The taper attachment provides sufficient taper so that pipe taps and similar work can be milled.

A V-bearing 12 inches long in the rear of the bed

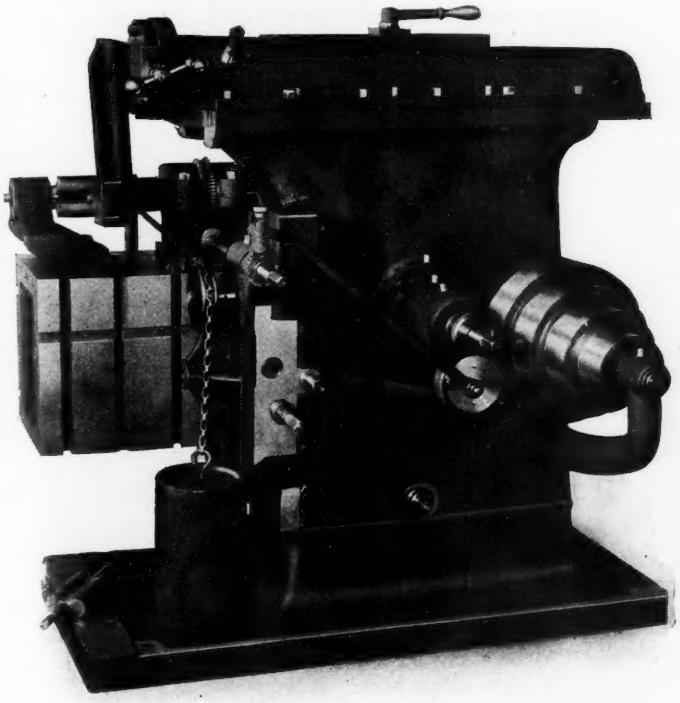
and a flat bearing in the front of the bed are provided for the carriage. The lead-screw is placed in the center of the machine and its center line is only 3½ inches removed from the center of the cutter. The lead-screw nut is held in a fixed position lengthwise, but can be rotated slightly. An arm is fastened to the nut, and its outer end is held by a spring against a swivel-bar. With this device the feed of the carriage can be accelerated or reduced by setting the swivel-bar at an angle, thus obtaining an increased or decreased lead, and making is possible to cut an accurate thread with a slightly inaccurate lead-screw.

At the left end of the lead-screw a hand-operated clutch is provided. This clutch is disengaged when the cut is completed, so that the carriage can be returned to its starting position by turning the handwheel attached to the right-hand end in Fig. 1. A friction index, similar to the one used on the cross-slide screw, is attached to this handwheel.

The maximum length of thread that can be cut in this machine is 6 inches, and the maximum diameter 2 inches. If the portion of the work which is not threaded does not exceed the chuck capacity—5/8 inch in diameter on one end, or the size of the tailstock spindle, 13/16 inch, on the other end—then the work can have any desired total length, as it can pass right through the spindles. The machine illustrated is of the universal type. For manufacturing purposes a plain machine will be made by omitting the horizontal swivel of the cutter head, the taper turning attachment, the screw compensating bar, and the extra tailstock spindle and change gears. The machine is fitted with a pan base 14½ by 26½ inches. An individual oil pump will be provided if desired. The weight of the machine as illustrated, without pump, is 190 pounds.

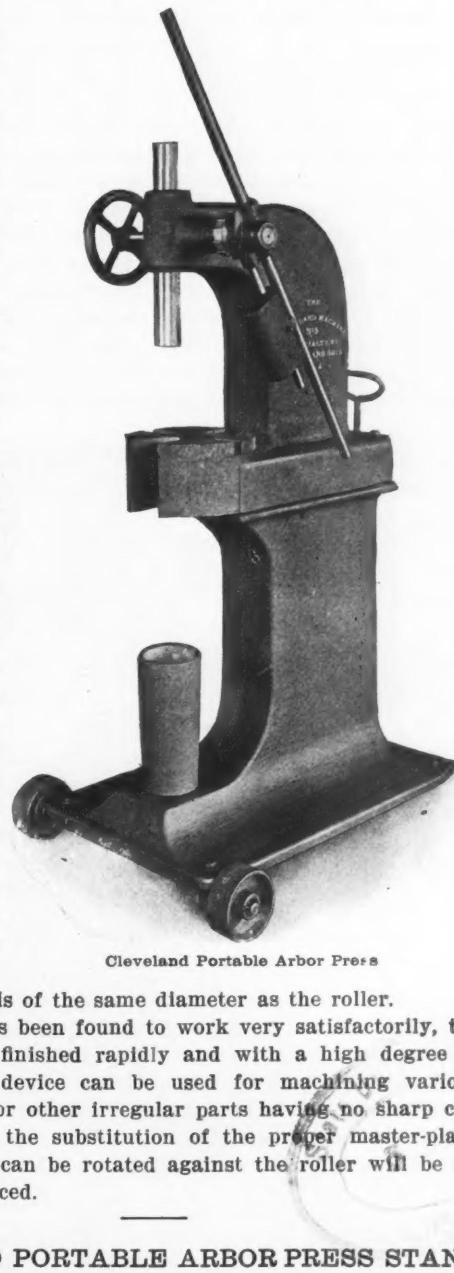
ATTACHMENT FOR ROCKFORD 16-INCH SHAPER

A special attachment recently built by the Rockford Machine Tool Co., Rockford, Ill., for a customer, that is intended to be applied to the regular 16-inch Rockford shaper is shown in the accompanying illustration. (This machine was described in the November, 1905, issue of MACHINERY.) The device as applied to the machine is designed for automatically machining the impellers or exhausters used in vacuum cleaning machines, one of the finished impellers being shown on the base of the shaper. Another impeller is shown set up in the machine, ready for the machining operation.



Attachment for Machining Parts with Curved Outline, made by the Rockford Machine Tool Co., Rockford, Ill.

The fixture is applied on the table of the shaper and consists of an inner and outer bearing, the inner or head bearing carrying a hollow spindle with work driver on the outer end and a master-plate or cam on the inner end; this cam is of the exact form of the work to be machined. The cross-feed screw of the machine is removed so that the saddle with the work-table is free to move on the cross-rail slide. The master-plate or cam is held against a roller by the weight shown. The rotating motion of the cam is produced by a worm and wheel, the worm being attached to the feed shaft of the device and operated in a manner similar to that by means of which motion is ordinarily transmitted to the regular cross-feed of the saddle. The roller pressing against the cam is mounted on a stud held in a casting clamped in a fixed position to the vertical slide of the shaper column. Hence the whole table, with fixture and work, is caused to move back and forth when the cam rotates. The cutting tool used is of circular contour and is of the same diameter as the roller.



Cleveland Portable Arbor Press

The fixture has been found to work very satisfactorily, the impellers being finished rapidly and with a high degree of accuracy. The device can be used for machining various shapes of cams or other irregular parts having no sharp corners, simply by the substitution of the proper master-plate. Any shape that can be rotated against the roller will be accurately reproduced.

CLEVELAND PORTABLE ARBOR PRESS STAND

In many shops where there is need for only one or two arbor presses, it is often desirable to have one of these presses on a certain floor or part of the shop where the work is to be done. As it would be very inconvenient and often impossible to mount the press on a bench located near the work, or to use a stationary stand, the Cleveland Machine Specialty Co., 1523 Williamson Building, Cleveland, O., has placed on the market a portable stand suitable for the Nos. 5 and 6 Cleveland arbor presses. The particular stand illustrated is equipped with a No. 5 press similar to the one illustrated and described in the department of New Machinery and Tools for October, 1910. The stand of this press is of box construction and open in the back. Ribs inside the column permit the use of three shelves for holding arbors, collets, broaches and other special fixtures which it may be desirable to keep with the press when it is moved about. The stand has a depth of throat of 10 inches which is the same as the press itself, so that there is clearance under the bed for work up to 20 inches in diameter. A pot is provided for receiving the arbors as they drop from the work. This receptacle has a lead-lined bottom to prevent injury to the arbors and may be detached from the base when necessary. This stand is also made without the truck when it is desired to keep it permanently in one place. The net

weight of the portable stand is 450 pounds, and with a No. 5 press, as shown, 880 pounds. The floor space required is 24 by 41 inches.

GRAND RAPIDS PLAIN MILLING MACHINE

A milling machine of a plain type, which is a recent product of the Grand Rapids Machine Tool Co., Grand Rapids, Mich., is shown in Fig. 1. This machine, while similar in its general design to other millers of the column and-knee type, has a number of features which give it greater rigidity and strength, as well as convenience of operation.

The column, which is cast in one piece, has an exceptionally wide base to resist the overhanging weight of the table when the latter is at the extremes of its travel. The knee is one of the box type with an extended top and an extra long bearing on the column. As the engraving shows, it is fitted with a telescoping screw for vertical adjustments. The saddle is equipped with a compensating stationary nut; it is very deep and has a length of 22 inches. The table has a working surface of 8 by 32 inches, and T-slots which extend beyond the oil pockets; this gives additional space for fixtures, etc., and if

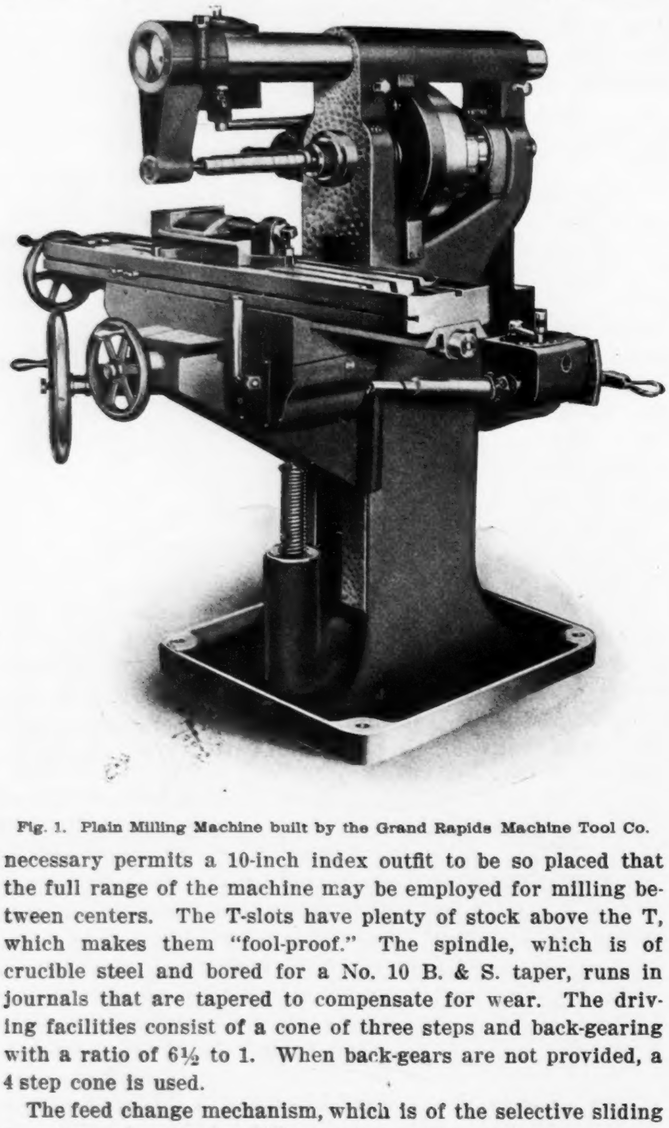


Fig. 1. Plain Milling Machine built by the Grand Rapids Machine Tool Co.

necessary permits a 10-inch index outfit to be so placed that the full range of the machine may be employed for milling between centers. The T-slots have plenty of stock above the T, which makes them "fool-proof." The spindle, which is of crucible steel and bored for a No. 10 B. & S. taper, runs in journals that are tapered to compensate for wear. The driving facilities consist of a cone of three steps and back-gearing with a ratio of 6½ to 1. When back-gears are not provided, a 4 step cone is used.

The feed change mechanism, which is of the selective sliding gear type, gives twelve different feeds. The mechanism for obtaining these feed changes is shown in the phantom view, Fig. 2. On the upper shaft shown, which is driven from the spindle by a nickel steel chain and sprockets, there are two driving gears, either of which may be engaged or disengaged with their shaft by means of a driving key that is operated by the push-rod to the right. These gears are in mesh with corresponding gears on an intermediate shaft, which has two speeds depending on the position of the driving key. Connecting with this intermediate shaft there are two sets of tumbler gears, which are driven independently by gears of different sizes on the intermediate shaft. These cones of tumbler gears are identical and each contains three different sizes. By the engagement of the sliding gear to the left (through which the table feed mechanism is driven) with the different tumbler gears, six speeds are obtained for each position of the driving key, thus giving twelve in all. This sliding gear is brought into the correct position by the indexing lever on the top of the case, which has six positions. The tumbler gears are brought into proper mesh with the sliding gear by engagement of the large lever shown, with one of its

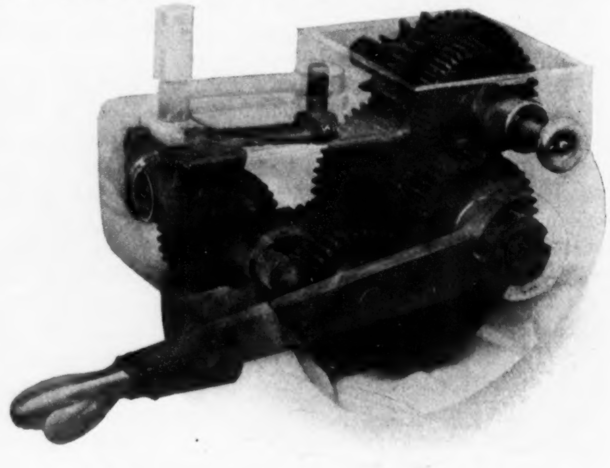


Fig. 2. Phantom View of Feed-changing Mechanism

three indexing holes. The feed per revolution for the various gear combinations is indicated by an index plate attached to the case.

In the phantom view, Fig. 3, the table feed controlling mechanism is shown. The central spur gear in the group of three shown is driven by the telescopic shaft from the feed change box. The outer spur gears are mounted on shafts carrying right- and left-hand worms, which are engaged or disengaged with their worm-wheels by rocking them about the central driving gear. This rocking movement is effected by the lever shown. When this lever is thrown to the left, longitudinal feed in that direction is obtained, while a movement to the right gives a feed in the opposite direction, and the central or neutral position disengages the feed.

The table has a maximum longitudinal travel of 24 inches, the saddle a cross movement of 8 inches, and the knee a vertical adjustment of 18 inches. The machine is fitted with a substantial arbor brace, and a countershaft with friction clutches and ring oiling boxes; a complete set of wrenches, a large vise, and an oil pot of liberal capacity are included in the equipment.

Fig. 3. Feed-controlling Mechanism

PRATT & WHITNEY RELIEVING ATTACHMENT

The relieving attachment manufactured by the Pratt & Whitney Co., Hartford, Conn., has been improved and a number of refinements in the construction introduced which have increased its scope of usefulness considerably. These changes,

by making possible the use of cams with sharp rises, have adapted the attachment, which is essentially for the radial and spiral relieving of hobs, cutters, taps, etc., to the boring or turning of irregular shapes, such as ellipses, etc., or those having sharp corners, such as squares or hexagons.

An example of the work done with this attachment is shown in Fig. 1. The part shown has a hexagonal hole through it, and the exact condition of the work as left by the boring tool is indicated by the illustration, the sharp corners having been formed by the tool. The adaptability of this attachment for internal work makes it useful for boring such

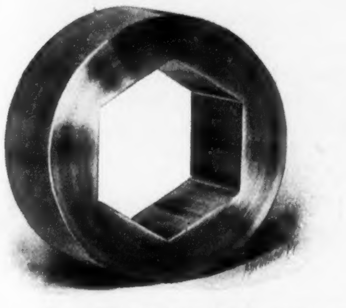


Fig. 1. Part with Hexagon Hole bored, by Use of Pratt & Whitney Relieving Attachment

Fig. 2. Hob that was relieved and ground on Angle of Thread with Pratt & Whitney Attachment

parts as square or hexagon socket wrenches and similar work, as practically the entire stock can be removed with the boring tool.

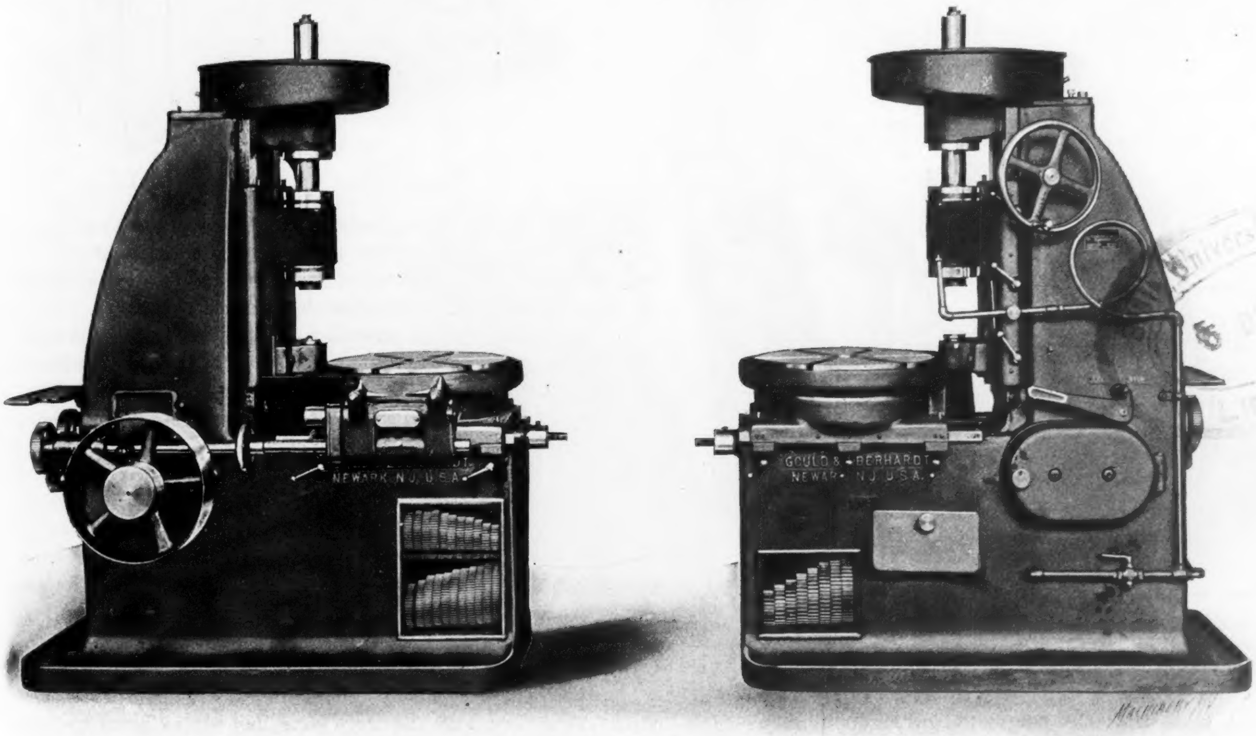
Hobs of extreme accuracy, which would ordinarily be considered a difficult proposition, are relieved, it is claimed, by the use of this attachment without the slightest difficulty, and the operation requires no chipping or filing which would distort the correct shape of the teeth, thus rendering the hob or tap useless after the first sharpening. In Fig. 2 an accurate hob is shown which has been relieved and also ground on the angle of the thread after hardening by means of this attachment.

The method of applying this attachment to the back of a lathe is a distinct advantage, in that it is always ready for instant use, and at the same time its position is such as not to interfere with the use of the lathe for other work. This attachment is also made in a slightly modified form for the side relieving of cutters, counterbores and similar tools. It may be applied to any of the Pratt & Whitney 14- and 16-inch lathes.

GOULD & EBERHARDT CONTINUOUS MILLING MACHINE

The vertical milling machine, two views of which are shown in the accompanying halftone, is now being manufactured by Gould & Eberhardt, of Newark, N. J. In the construction of this machine it has been the object of the manufacturers to produce a simple tool having a powerful drive both for the spindle and for the continuous revolving table. It is designed for the use of high-speed steel cutters and is intended particularly for the rapid production of duplicate work of a class that can be inserted in a suitable fixture and removed without stopping the machine, thus eliminating any waste of time.

The main body or frame is cast in one piece and is of the box section construction, making it strong and rigid. The faceplate or revolving work-table is integral with the worm-wheel which lies just below the table, thereby reducing to a minimum any torsion at this point. The driving worm which engages this worm-wheel has a coarse pitch, is made of high-carbon steel, and is hardened and ground. If desired, the driving worm can be quickly disengaged from the worm-wheel, so that the table can be revolved by hand. This enables the operator to see if work which is to be milled on the periphery runs true. Means are provided for taking up any wear which may occur between the worm and the worm-wheel. The table is direct gear-driven and it has circumferential changes of feed for the work, ranging from 4 inches to 14 inches per minute, the variations in feed being obtained by means of



Vertical Milling Machine built by Gould & Eberhardt

change gears. The table revolves upon a large floating washer and it is mounted on a slide that may be adjusted longitudinally. The movement of this slide and the work-table is indicated by a dial graduated in thousandths of an inch. The slide is provided with a guard that encloses the table, thereby preventing chips from being scattered over the machine and floor. By means of a small scoop attached to the revolving table, the chips are automatically conveyed to the base of the machine.

The spindle, which is of large diameter and is made of chrome-nickel steel, runs in bronze bearings and has hardened and ground steel thrust washers. Means are provided for taking up any wear that might take place in the main spindle bearing. The spindle is threaded on the end to accommodate end or face milling cutters, and there is also a slot or keyway for driving these cutters. The spindle is also arranged to receive the ordinary taper-shank cutters, and is provided with a draw-bar through the center for holding such cutters firmly in position. The drive to the spindle is by belt to a single pulley at the side of the column, connected to a vertical shaft that, in turn, transmits power to the spindle through spur-gears. The main spindle slide, which is in one piece with the bearing, is long and rigid and may be adjusted vertically. On its lower end it carries an outer support for the spindle, which support can also be adjusted vertically independent of the main slide.

If desired, a pump may be furnished with the machine, located in the base of the frame. An oil pan that extends around the bed catches any lubricant that might drop around the machine. The total weight of this miller is 3000 pounds. It is strictly a manufacturing tool and the parts are designed to meet modern requirements.

OSBORN MOLDING MACHINE

The Osborn Mfg. Co., Cleveland, O., has placed on the market the molding machine illustrated herewith. This machine is of the "direct-draw", roll-over type, and is designed to supply a method of molding dry-sand and green-sand cores or drags.

The lower portion or drawing table of this machine, as is shown in the illustration, can be swung out from under the frame, on which is mounted the flask and pattern. After the mold is rammed and rolled over by hand, the drawing table is swung into position beneath it; the core or green-sand drag

Osborn "Direct-draw" Roll-over Molding Machine

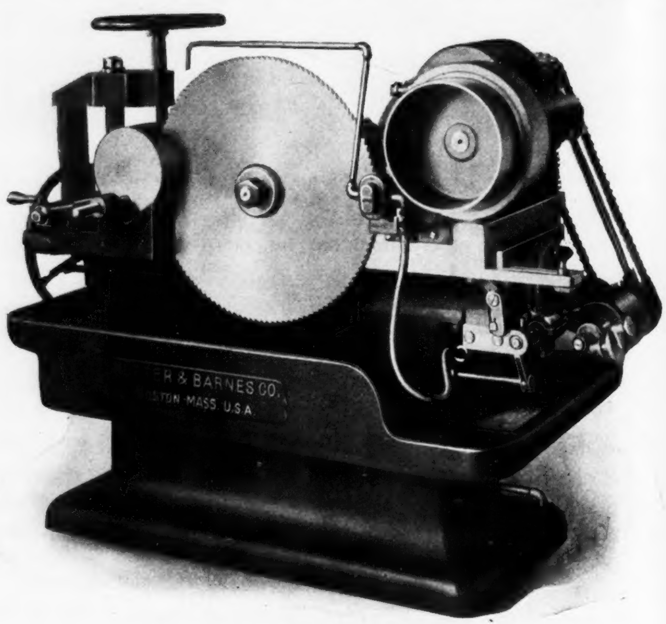
can then be drawn down from the pattern by a half turn of the crank, giving a full pattern draw of 7½ inches. The drawing table with the completed mold upon it can then be swung out at right angles to the rest of the machine, where it is in a convenient position for removing the mold.

If necessary, the mold can be swung back again and the machine will print back with considerable accuracy. It is claimed, however, that owing to the accurate draw and the elimination of all unevenness in the bottom boards or dryer plates by the automatic leveling device on the drawing table, printing back becomes practically unnecessary, as the molds repeatedly come out in perfect form and without the vestige of a broken edge.

This machine is particularly adapted for the use of automobile manufacturers and others who have large quantities of cores or green-sand drags to make. It will be found convenient in the molding of housings, crank cases, gear cases and work of a similar nature. The machine is quick in its operation as well as accurate, and it is claimed that one man can easily turn out twice as much work with it as can two skilled molders on the floor.

NUTTER & BARNES SAW CUTTING-OFF MACHINE

The Nutter & Barnes Co., of Boston, Mass., has brought out the 8-inch metal cutting-off machine of the saw type shown herewith. The feeding mechanism of this machine has a sprocket chain drive which connects with a gear-box giving four changes of feed, ranging from ½ to 2 inches per minute. This gear-box is mounted on feed brackets at the rear of the machine. The driving sprocket for the feeding mechanism, which is mounted on the main driving gear pinion shaft, is held between two friction disks, to admit of its slipping should too much load be put on the feed, or the feed stop be set



Nutter & Barnes 8-inch Cutting-off Machine

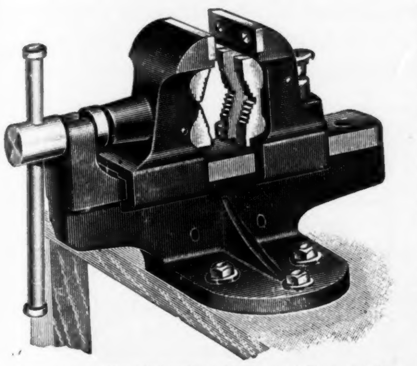
to trip at the wrong time. The feed is engaged by a foot-lever at the front of the machine (not shown in the engraving), the connection being made with the worm-shaft for engaging the worm and wheel by a suitable rod.

This machine has central spur gear drives throughout. The saw-spindle connecting gears, which are phosphor-bronze bushed, have a 4-inch face and are of 5 diametral pitch. The saw spindle is 3 inches in diameter and is equipped with four driving pins ½ inch in diameter. The main driving gear is 18 inches in diameter and has a 2½-inch face. All the driving gears (except the 18-inch size and the back-gears) and shafts are of crucible machinery steel forgings of 0.50 carbon. The saw is 22 inches in diameter and 3/16 inch thick. It will take a maximum depth of cut of 8 inches. The saw has two speeds obtainable from a cone pulley, and a similar number through the back-gears, which have a ratio of 43 to 1. The carriage is 22 inches long, 17 inches wide, and it has a movement of 9 inches. The plain work-table measures 18½ by 13 inches, and the work-shoe has a maximum capacity for 8-inch round stock. The height of this shoe from the floor is 30 inches.

By removing the work-shoe, provision is made for using a bevel gage on the plain work-table when cutting flats, squares and structural shapes, at an angle. An oil pump is provided to supply lubricant to the saw, and there is a large reservoir inside the base. A drip pan cast integral with the upper part of the base surrounds and forms a part of it. A stock support with adjustable screw elevation, and a counter-shaft with a 14 by 4½-inch friction pulley, is included in the equipment. The floor space occupied is 2 feet 6 inches by 4 feet 8 inches, and the net weight is 2500 pounds.

ARMSTRONG COMBINATION PIPE AND BENCH VISE

The accompanying illustration shows an improved design of quick-adjusting combination pipe and bench vise which is now being built by the Armstrong Mfg. Co., 297 Knowlton St., Bridgeport, Conn. The pipe vise is provided with four hardened steel serrated V-blocks. The rear jaw is free to slide along the base and it is firmly held in position by a pin which engages holes in the base. There are three of these holes and, consequently, three positions for the jaw. When the pin is in the first hole, the vise has a capacity for pipes ranging in diameter from 1/8 inch to 1 inch; when the jaw is moved to the second position, pipes up to 2 inches in diameter may be held, and when in the third position, it will grip 2½- or 3-inch sizes. The changes for the different sizes are quickly obtained, which is a feature that will readily be appreciated by any engineer or steam-fitter. This vise is made of malleable iron and has a steel screw. As the engraving shows, the vise proper has steel-faced jaws, so that it is also adapted to the work of an ordinary vise. Sockets for legs are provided, so that by the use of 1¼-inch pipe a stand can be made which enables the vise to be set in the most convenient position.


Armstrong Combination Pipe and Bench Vise

SPRINGFIELD-BRANDES VERTICAL GRINDING PLANER

The Springfield-Brandes vertical grinding planer shown in Fig. 1 is a new design that has been brought out by the Springfield Mfg. Co., Bridgeport, Conn. This machine has been greatly improved in its general construction as well as in its details. The design is heavy and substantial throughout, the weight of the grinder being 8000 pounds.

The particular machine illustrated has a capacity for grinding widths up to 12 inches, a height of 12 inches, and a length of 4 feet, though the capacity as to length can be increased if desired. The wheel head and spindle are of a particularly heavy design, the spindle being large in diameter and mounted in long bearings. It is provided with ball thrust bearings on the under side and is equipped with a ball-bearing spring take-up on the upper part of the bearing to prevent backlash when the wheel is running off the work. The driving pulley is mounted upon an independent bearing which relieves the spindle of all belt strain. The grinding wheel is 16 inches in diameter and it is mounted in a chuck which permits the wheels to be easily changed. In case of damage to a wheel, the danger of accident is avoided by the use of a guard giving ample protection.

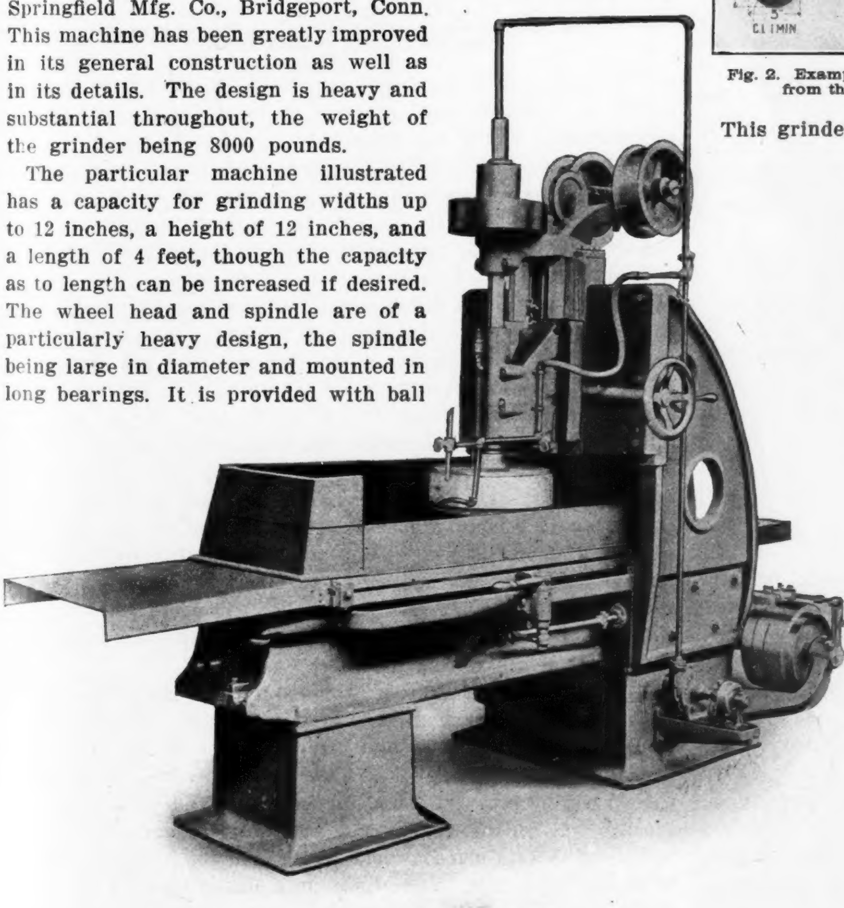


Fig. 1. Grinding Planer built by the Springfield Mfg. Co.

This grinder, as the illustration shows, has all the advantages, as far as rigidity is concerned, that are possessed by the modern planer; in fact, there is a striking similarity in the general appearance of the two machines. The table drive is of the general planer construction, except that the power for the grinder is transmitted through a worm and worm-gear at the rear of the machine direct to a large and substantial screw, which runs through a long nut, thus giving a smooth action to the table. The machine, as shown, is arranged with a hand feed for feeding the wheel to the work, and the adjustments of the wheel are as indicated. While the design illustrated is arranged for hand-feed only, it will also be built with a power feed when desired.

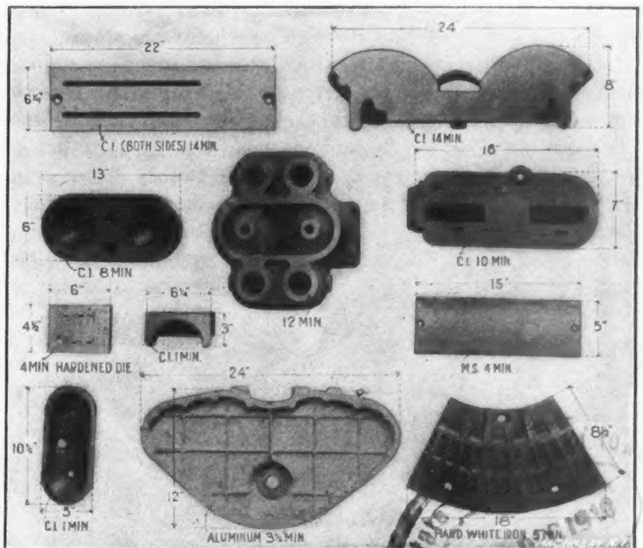


Fig. 2. Examples of Work done on Grinding Planer—All Parts ground from the Rough and from 1/32 to 1/8 inch Metal Removed

This grinder is furnished with a pump for supplying lubricant to the wheel and the lubricant can be applied either through the spindle or from the outside. This pump is mounted on a bracket that is bolted to the base, and it is driven by belt from a pulley on the driving shaft. The lubricant is forced through the vertical pipe shown, to the outside or inside of the wheel by the manipulation of two valves located at the junction of the vertical pipe and lower outside connection. When applied through the spindle, the water is forced against a deflector on the under side of the spindle so as to force it to the periphery of the wheel, which is essential when grinding narrow or interrupted surfaces. The guard around the table, which encloses the work, is made in sections on the front side, so that it can be easily removed. The engraving shows the planer with the upper section of this guard taken off.

In Fig. 2 some examples of the work ground on this machine, together with the dimensions of the various parts and the time required in grinding them, are shown. In all cases these parts were ground from the rough, the wheel removing anywhere from 1/32 to 1/8 inch of stock. The time could, of course, have been considerably reduced if the proper amount of finish had been allowed on these pieces for grinding, which method of finishing does not require, of course, anywhere nearly as much stock as a milling or planing operation.

SCHUCHARDT & SCHUTTE AUTOMATIC WORM MILLING MACHINE

Schuchardt & Schutte, 90 West St., New York City, has placed on the market a thread milling machine, which is adapted to the milling of right- and left-hand worms, to the cutting of spiral gears of extreme angles, and for other helical milling operations, such as the threading of bolts, etc. This machine, which is shown in Figs. 1 and 2, is similar in some respects to a universal milling machine when the latter is set up for helical work, in that the table has a longitudinal movement past the cutter and there is a dividing head through which the work is rotated.

The milling cutter on this machine is rigidly mounted and, aside from its rotary movement, remains stationary. The work is supported on an arbor carried in an index head and outer support, or between centers. It has a longitudinal movement depending, of course, on the lead of the thread being milled, which is obtained through change gearing. The drive to the cutter spindle is by belt to a 3-step cone mounted on a horizontal shaft passing through the center of the head; this shaft drives an intermediate shaft which transmits movement to the cutter spindle through spur gears having a ratio of 2½ to 1. The casing in which these gears are enclosed may be seen in Fig. 1. The drive to the work-arbor is taken from an intermediate shaft in the head, which is connected to the driving shaft of the change gear box by a chain-and-sprocket drive. From this box, in which twenty speed variations for the work may be obtained, the movement is transmitted to a horizontal shaft extending to the front of the machine, which connects with a splined driving shaft beneath the table. This splined shaft transmits motion, through bevel gears, to the worm-shaft of the dividing head, which, in turn, drives the work-arbor through a 40-tooth worm-wheel. Longitudinal movement is given the work-table by a lead screw which is connected to the splined shaft through change gearing for obtaining various pitches. The gears included in the equipment enable leads ranging from ¼ to 10 inches to be obtained, and by making a slight change in the gearing, a maximum lead of 20 inches is available.

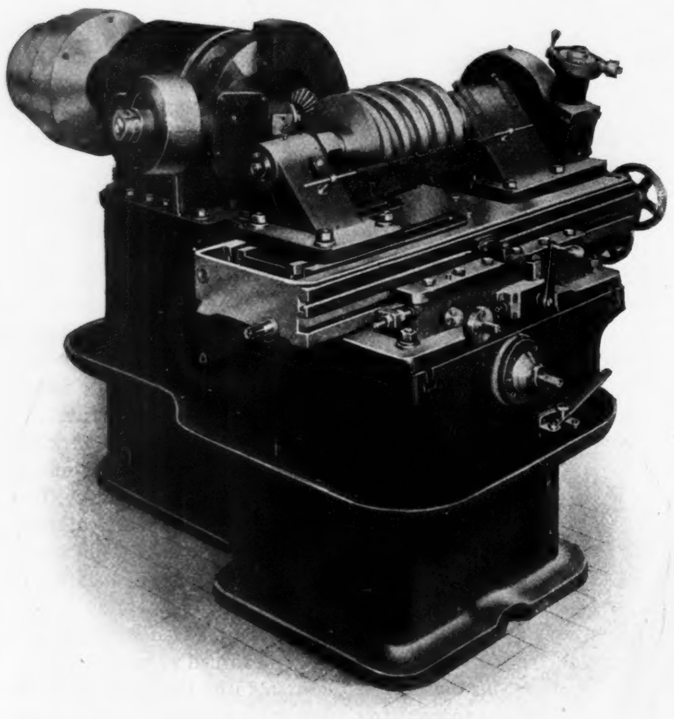


Fig. 1. Schuchardt & Schutte Worm Milling Machine

The cutter spindle is mounted on a swiveling head, so that the cutter can be set to the helix angle of the thread. This head may be adjusted to an angle of 45 degrees on either side of the zero or vertical position of the cutter. The cutter spindle and driving shaft are inclined backward to an angle of 12½ degrees from the right-angle position. The object in setting the cutter spindle in this angular position is to obtain a large ratio of gearing between the cutter spindle and its driving shaft and also the use of a comparatively small cutter, without interference on the part of the spindle driving gears with the work or outboard support. Because of this offset position of the cutter spindle, the sides of the cutter itself are not equi-angular. For example, the cutter for milling an Acme thread would be made with an angle of 26½ degrees on one side and 2½ degrees on the other, so that each side would be at an angle of 14½ degrees with the axis of the work, which is the angle for the sides of a standard Acme thread.

When a thread is to be milled, the cutter is first set to the helix angle. The work, after being mounted in place, is then set to depth by feeding the table inward. This is done by applying an interchangeable handled lever to the squared feed-screw shown, which has a graduated collet reading to thousandths of an inch. When the work is correctly positioned, the saddle may be securely locked to the bed by tightening four locking bolts. If desired, the thread, even when of coarse pitch, may be finished in one cut, though for extremely accurate work a finishing cut would be taken. The travel of the table may be automatically disengaged by an adjustable stop located at the front as shown. A conveniently located lever also provides means for stopping the work by hand. If a bastard thread or one whose pitch is coarser than any available cutter needs to be milled, this may be accomplished by adjusting the table and work longitudinally, after one cut has been taken, means for making this adjustment being provided. On the speed change gear box, an index plate shows how the change gear levers should be set for milling various diameters. The speeds obtained in this way are, of course, tentative, and subject to variation for different materials. The index plate also shows the circumferential feed of the work per revolution of the cutter for different positions of the speed controlling levers.

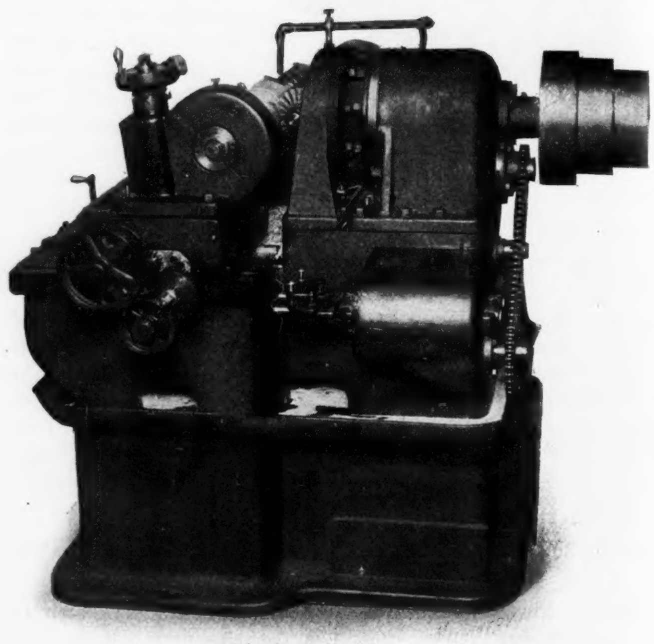


Fig. 2. Side View showing Outboard Support for Swiveling Head and Gear Box for Controlling Work Speed

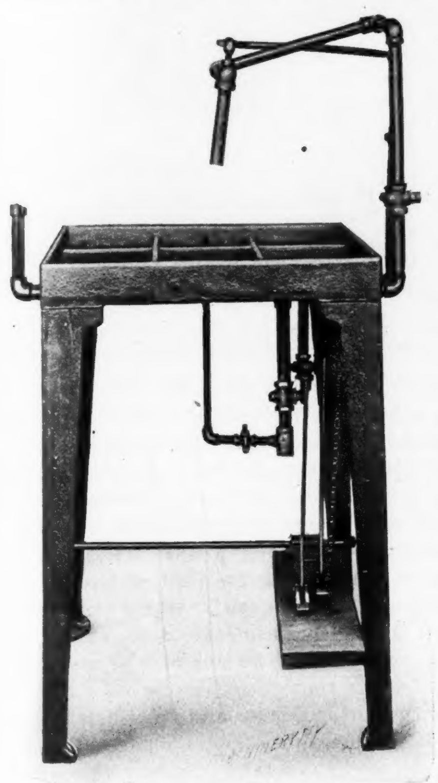
A dividing mechanism is provided for indexing the work when milling multiple threads or spiral gears. The machine is provided with a pump and reservoir (not shown) for supplying lubricant to the cutter, and there is also a large pan cast integral with the base for catching and returning all lubricant to the reservoir. The maximum diameter that can be milled in this machine is 9 inches and the greatest length of thread, 16 inches. The minimum distance between the cutter and work-arbor is 2⅛ inches. The circumferential feed of the work per revolution of the cutter ranges from 0.012 to 0.052 inch. The regular equipment includes a countershaft, a reservoir and pump for supplying lubricant, one work-arbor,

a complete set of wrenches and the other accessories necessary to operate the machine.

An important feature in the design is the means for giving additional rigidity to the cutter. This consists of a heavy bracket that is bolted to the outer face of the swiveling head, thus reducing the unsupported overhang to a minimum. The machine is massively constructed throughout as the illustrations show, and it is capable of accurate work and rapid production.

LUCAS BRAZING FORGE

In shops where much soldering or brazing is done the gas bill is an important item of shop expense. In order to decrease to a minimum the amount of gas used in brazing, J. L. Lucas & Son, of Bridgeport, Conn., have brought out the brazing forge shown herewith. This forge is the outcome of considerable experience in brazing and soldering of automobile parts, and the principal points claimed for it are economy and efficiency.



Brazing Forge with Foot Treadle for Controlling Gas and Air Supply

The chief difference between the design of this and other brazing forges is the addition of a foot-treadle for controlling the gas and air supply. This treadle is hinged at the rear of the forge, and two connecting-rods which are attached near the center of the treadle extend to the gas and air valves located in the supply pipes. Normally, this treadle is kept raised by a spring, which is shown attached to the under side of the table. When in this upper position, both the air and gas valves are open to the extent that they have been adjusted for, but as soon as the brazer presses the treadle down both the air and gas are automatically shut down sufficiently to give only a pilot light. If the brazer desires to leave the forge, the treadle may be swung into a latch near the bottom of the leg near the treadle, which holds it in the downward position. Thus it will be seen that during the numerous intervals between jobs, when adjusting work, charging, or doing other work, the gas need not be left burning; furthermore, no time is wasted in adjusting the flame when it is again needed. It is claimed that this feature effects a saving of gas ranging from 15 to 25 per cent, and there is, of course, also a considerable saving in time, inasmuch as the adjusting of the air and gas each time the flame is shut down, before beginning another job, is rendered unnecessary by the foot control.

The illustration shows the forge equipped with a single torch, but double torches can also be furnished if desired. The table of the forge may be honeycombed for the reception of firebricks, or it can be furnished slotted to facilitate brazing bicycle tubing or similar work. The use of rubber tubes for connecting with the burner is eliminated in this forge by the construction of the piping shown above the table, which is flexible enough to permit the torch to be tilted to any angle. The castings, piping, and valves used on this forge are of the best quality and the forge itself is of strong and simple construction.

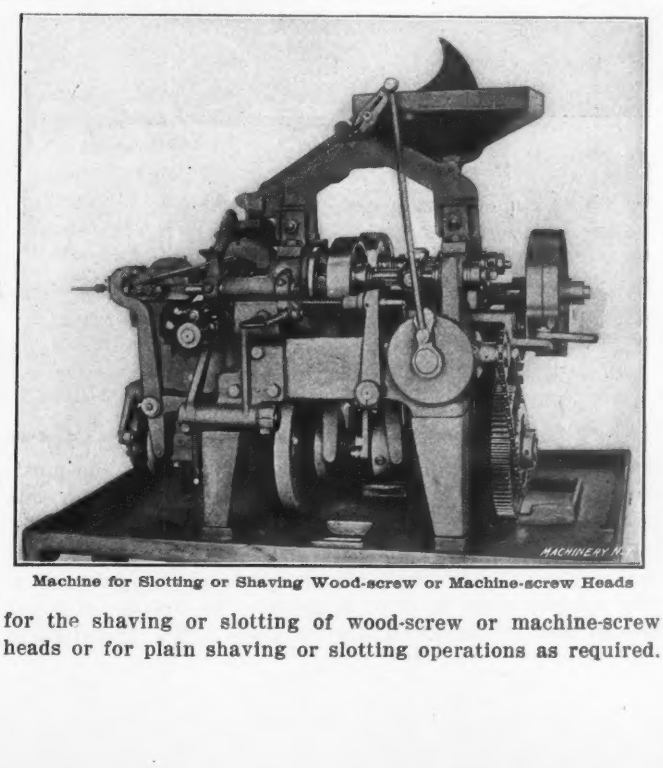
SIBLEY SENSITIVE DRILL PRESS

The accompanying illustration shows a new sensitive drill press of 16 inches swing that has been put on the market by the Sibley Machine Tool Co., of South Bend, Ind. In general lines this machine is of the standard type of light drill press, but it has the important feature of being self-oiling throughout. There is an oil chamber beneath each of the four horizontal bearings, which is filled with lambs' wool and saturated with oil. The oil is fed to the shaft by capillary action through a slot in the bottom of each bearing. The crown gear bearing is oiled by a wick which draws its oil from a chamber just back of the bearing. A tube screwed into the hub of the loose pulley contains a lubricating candle held against the shaft by a light spring. The spindle is not counterbalanced, but is held in any position by a brass friction. Miter driving gears insure quiet running at the highest speed, and a base of ample proportions makes the drill press solid and steady. With the countershaft running at 500 revolutions per minute, five spindle speeds, ranging from 150 to 1700 revolutions per minute, are obtained. The weight of this press is 300 pounds. The maximum distance from the spindle to the base is 44 inches, and to the table, 30 inches. The spindle is bored to receive a No. 2 Morse taper, and it has a feed of 8 inches. The table has a working surface of 10 by 12 inches. The machine occupies a floor space of 20 by 30 inches, and its maximum height is 68 inches.

Sibley 16-inch Sensitive Drill Press

MANVILLE SHAVING AND SLOTTING MACHINE

The E. J. Manville Machine Co., of Waterbury, Conn., has recently perfected a new shaver and slotter which is intended for the shaving or slotting of wood-screw or machine-screw heads or for plain shaving or slotting operations as required.



Machine for Slotting or Shaving Wood-screw or Machine-screw Heads

The principal points of advantage of this shaver and slotter are extreme accuracy as to the diameter of head, the central location of the slots, and a head that in every case is round and true with the body.

All screws up to 4 inches in length are pushed into the spindle as far as the head, no back-rest being used to throw the heads out if the blanks are imperfect. The blank is held in a split chuck similar to that of automatic screw machines. The slotting saws are mounted on a rigid bracket and can be instantly adjusted to bring the slots central with the head of the screw. The fact that the screw head is turned by being held entirely in the spindle, and that the spindles are mounted rigidly in the frame, insures every head being round and having a smooth finish. The life of the tools is also increased.

These machines handle all sizes of screws from ¼ inch (No. 0) up to 4 inches (No. 20). Large and small hoppers are provided that are not only interchangeable on these machines, but also interchange with the wood-screw threaders built by this company. All cams and other operating parts of the machine are easy of access, and nearly every adjustment may be accomplished while the machine is in motion. The shaving tool is so mounted that it can be brought to the head of the tool at any desired angle, so that heads may be made to the correct angles even if the tool itself is incorrectly formed. As nearly all movements are yielding and some in both directions, it is practically impossible to break any of the machine parts. All movements are also governed by positive stops instead of being brought to their working points by the cam faces alone. Any operator familiar with shavers of the old type can readily operate this new design, as the action of the tools is, of course, practically the same, the only radical difference being that both spindles are rigidly mounted in the frame and each spindle has its own set of tools which gives extreme accuracy to the product and increases the production, as it is unnecessary to throw the spindle over from side to side.

SENECA 14-INCH QUICK CHANGE FEED ENGINE LATHE

The accompanying illustration, Fig. 1, shows a new 14-inch quick change feed engine lathe placed on the market by the Seneca Falls Mfg. Co., 330 Water St., Seneca Falls, N. Y. This lathe is provided with several new features not found in earlier designs, one of these features being the quick change feed mechanism, and another the micrometer stop for the cross-slide, shown in Fig. 2. The feed mechanism consists of a cone of eight steel gears located on the lead-screw at the right-hand side of the feed cage. A tumbler gear on a lower shaft can be brought into mesh with any one of the eight gears. This tumbler gear, in turn, is given three changes of speed through another tumbler and set of gears at the left-hand end of the gear cage. By means of the lever at the end of the headstock, two speed changes are imparted to the set of gears in the left-hand end of the cage, so that the lead screw, which is also used for the feed-rod, can be given forty eight changes in all. All standard threads from 1½ to 92 per inch, including 11½, and feeds ranging from 0.0023 inch to 0.144 inch per revolution of the spindle, can be obtained. The index plate provided shows clearly how to instantly obtain any desired number of threads per inch or any required feed.

Fig. 1. Fourteen-inch Lathe made by the Seneca Falls Mfg. Co., Seneca Falls, N. Y.

The micrometer stop for the cross-slide, shown in Fig. 2, permits minute adjustments to be easily made. The location of the stop is adjusted by means of a worm-gear operated by a worm or screw with a knurled knob. The adjustment is determined by graduations on a micrometer barrel, these graduations being about ⅛ inch apart and each equivalent to a 0.00025-inch motion of the stop. The stop mechanism is thrown in and out of engagement by pushing in and out a knob inside of the handwheel. The stop acts directly on the cross-feed screw, and is therefore more effective than a stop which acts on the cross-slide. It is positive and will be found of great advantage in the operation of the lathe, as it saves time and is conducive to accuracy. The stop may be used when the taper attachment is in action.

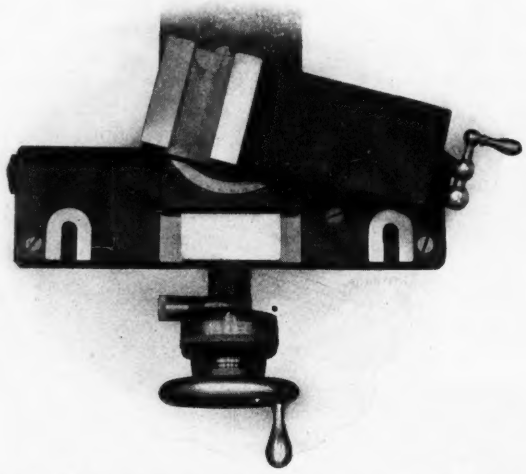


Fig. 2. Micrometer Stop for the Cross-slide, as applied to the Seneca 14-inch Lathe

The reverse mechanism for both cross and longitudinal feeds and lead-screw consists of a set of spur gears and a clutch in the headstock operated through levers connected by the reversing rod to a hand lever on the apron, thus giving the operator control of the lathe from his normal position in front of the machine. This mechanism eliminates the reversing of the belt on the countershaft, and provides for sixteen forward speeds of the head spindle. An automatic stop for the carriage can be operated in either direction by means of adjustable stops on the reverse rod.

The general design of the machine makes it suitable for heavy work. The headstock is of a deep web pattern, with forged crucible steel spindle revolving in large bearings and ring oiled. The driving belt is 2½ inches wide. A new binding device, which is patented, secures the plain and compound rest to the cross-slide. This device facilitates the adjustments, and by omitting the usual slots for the binder bolts, the cross-slide is strengthened. All carriages are arranged for taper attachment, which may be affixed to the machine at any time. The cross-feed screw is provided with a graduated collar, reading to 0.001 inch, the graduations being about 1/16 inch apart. An automatic safety device, also patented, makes it impossible to engage opposing feeds at once. One feed is automatically disengaged when another is thrown in. The feed gearing is disengaged when threads are cut, and the handwheel for the longitudinal feed does not revolve.

MOLLER LATHE CHUCK FOR TURNING OVAL OR ROUND WORK

The lathe chuck shown in Fig. 1 has been designed for the turning of oval patterns, punches and dies of oval shape, or for work of a similar character. The designer and manufacturer, Mr. J. A. Moller, Box 240, New Rochelle, N. Y., has endeavored to produce a chuck which would be adapted to oval turning and at the same time be convertible into an efficient plain chuck for round turning.

The construction and operation of this chuck will be more apparent by reference to Fig. 2, which shows the chuck proper removed. Attached to the lathe headstock there is a stationary base-plate *B* upon which is mounted a slide *C* that may be adjusted horizontally, the adjustments being effected by turning shaft *S* which, through worm gearing, rotates a screw *D* passing through a nut attached to the slide *C*. When this slide has been set in the correct position, it may be locked by the bolts *A* which pass through elongated holes. The chuck itself (when used for oval turning) is free to slide in the dovetail ways of ring *R*, and it also has a movement at right angles to these ways on the driving plate *E* to which it is dovetailed. When the chuck is in place, as shown in Fig. 1, this driving plate is screwed on the spindle and the projecting ring *F* sets into the annular groove *G*. When the lathe spindle and the driving plate *E* are rotated, the chuck is given a backward and forward movement (provided the ring *F* is set eccentric to the lathe spindle) which is correct for producing an elliptical shape. The proportions of this ellipse, or the difference between its major and minor axes, is determined by the position of the eccentric ring *F*, which may be adjusted as previously explained.

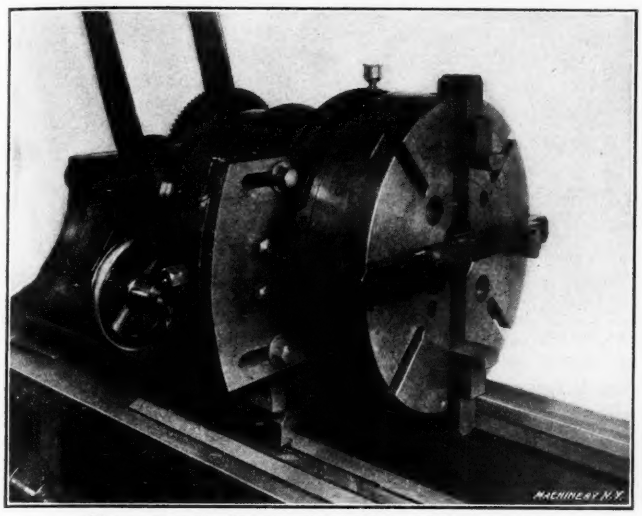


Fig. 1. Combination Chuck for Oval and Round Work

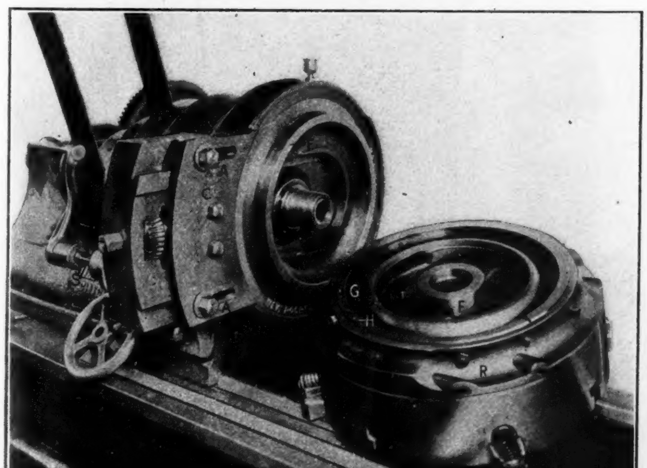


Fig. 2. View showing Chuck removed and Adjustable Slide for Varying the Ellipses

The chuck has a capacity for turning ovals having a maximum difference between the two axes of four inches. A scale on the top of the stationary base *B*, indicates the size of the ellipse, and a micrometer dial (not shown) on the screw *B* enables accurate adjustments to be made. The screw *S*, can, if necessary, be rotated uniformly by power, either from the main spindle gear or through the change gears so as to gradually alter the position of the eccentric ring. Such a uniform movement of this ring would be required when turning work having an oval shape—the ovals gradually diminishing in size but keeping the same proportion—to compensate for the inward or feeding movement of the turning tool. This power feed could also be employed to advantage for producing a surface which gradually changed in shape from oval to round, or *vice versa*.

When this chuck is to be used for round turning, the ring *F* is, of course, placed concentric with the spindle, and the driving plate *E* is locked to the chuck by screws which are inserted in the counterbored holes, seen in Fig. 1. The chuck also receives additional support from the ring *F*. All dovetailed slides are equipped with adjustable gibs, and means are provided for taking up wear around the eccentric ring, by the adjustment of a split tool-steel ring *H* which may be contracted by suitable screws. The driving plate is of tool steel, the adjusting screw of machinery steel, and the worm-wheel of bronze. The stationary part of the chuck or the base-plate *B* is easily attached to a headstock, and means are provided for adjusting it centrally with the spindle. The chuck itself is of the four-jaw independent type, and the attachment may be applied to any lathe having a swing of over 18 inches.

STANDARD TOOL CO.'S ADJUSTABLE REAMER

The Standard Tool Co., of Cleveland, O., has recently added to its line a new adjustable reamer which is known as the "Stana R." This reamer has been developed to meet the demand for an adjustable reamer that is simple in construction, readily adjusted to compensate for wear, and yet solid enough to stand the most severe service.

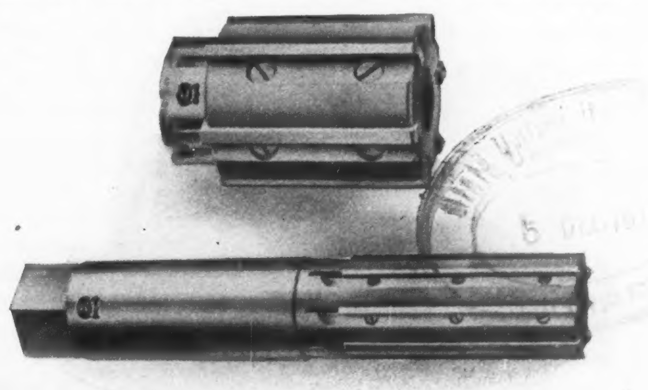


Fig. 1. Standard Adjustable Reamers of the Hand and Shell Type

The body of this reamer is made of hard, tough, machinery steel. The blades are unevenly spaced to prevent chatter and insure a smooth hole. Each blade is held rigidly in place by means of heavy screws provided with special shaped heads that are countersunk into the body of the reamer. The screw heads engage in V-shaped slots that are milled into the face of each blade, as shown in the sectional view, Fig. 2. This construction not

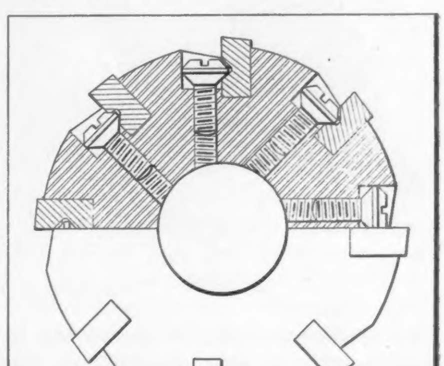


Fig. 2. Sectional View of Adjustable Reamer showing Method of Binding Blades

only seats and holds the blades rigidly against the bottom and back of the slot in the body—thus eliminating any tendency to spring—but prevents endwise motion as well.

The blades can be ground with end clearance for machine reaming or chucking work, as they extend a sufficient distance beyond the body to permit of this being done. After the blades are worn or when it is desired to increase the diameter, they can be taken out by removing the screws, and the diameter increased by placing a liner of some suitable material (preferably tin foil), and of the desired thickness, evenly in the slots under the blades, after which the blades are reground ready for use. By this method it will be seen that the blades can be adjusted until completely used up. By the substitution of new blades for those that are worn out, the reamer is to all intents and purposes as good as new.

"Stana R" reamers are furnished either in the hand or shell type and with carbon or high-speed steel blades.

LARGE TOGGLE DRAWING PRESS

The D. H. Stoll Co., of Buffalo, N. Y., has recently completed the large double-action toggle-motion drawing press, shown in Figs. 1 and 2. This press has been built especially for the heavy blanking and drawing work connected with the automobile trade, and it was primarily designed for drawing radiator fronts, the work being done in one operation from the blank. Samples of these fronts are shown in Fig. 3, those to the right being direct from the drawing die, while the one to the left has the center panel blanked out.

This press weighs 86,000 pounds, and has an over-all height of 14 feet. It is driven through gearing having a ratio of 35 to 1, which is arranged as shown in Fig. 1. The press is controlled by a lever extending t the front which operates a multiple disk friction clutch twenty-four inches in diameter. This clutch is fitted with friction blocks for a brake on its outside surface. It is designed for severe service and is capable of transmitting 100 horsepower at 250 revolutions per minute. The flywheel mounted on the driving shaft has a weight of 2300 pounds. The crankshaft, which is 8¼ inches in diameter, has two cranks of 7-inch throw. The pins of these cranks have a bearing of 10 inches and the shaft bearings are 17 inches in length. All these bearings are bushed with bronze specially proportioned to withstand great compression. The bolster plate measures 59 inches by 56 inches, which gives ample die space. The inside slide is 28 inches by 30 inches, thus permitting the use of a punch proportionate to the large die capacity.

The press is equipped with an outside or hold-down slide which is actuated by rock-shafts at the front and rear; these are connected with a slide at the side of the housing (as shown in Fig. 2), which, in turn, receives its movement from the main crankshaft with which it is connected by a pitman.

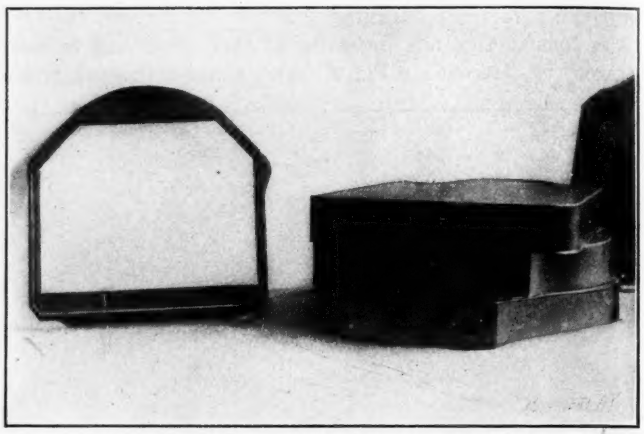
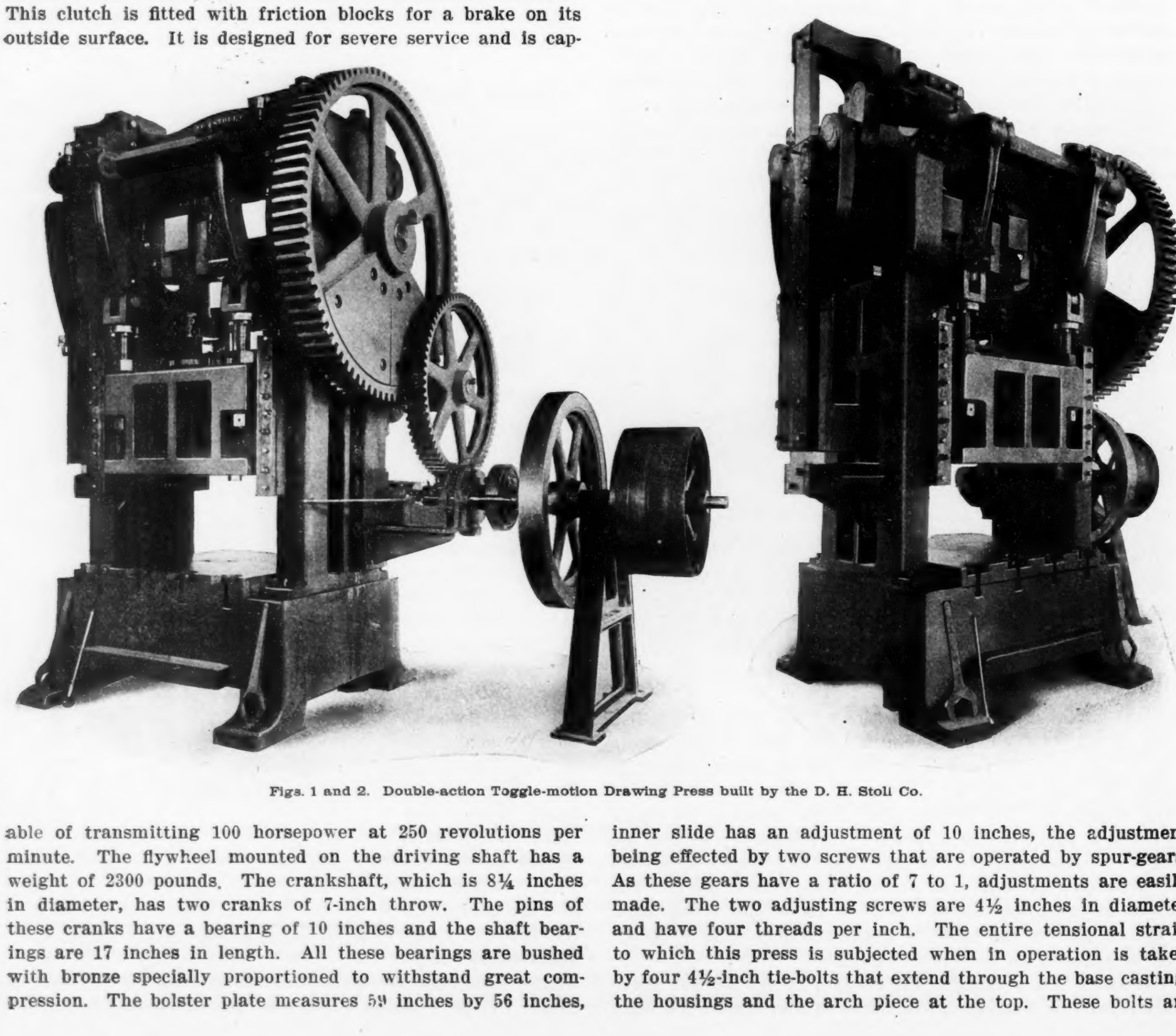


Fig. 3. Radiator Fronts Drawn on the Press illustrated in Figs. 1 and 2

This toggle motion gives an exceptionally long dwell to the hold-down slide when the latter is at the bottom of its stroke, so that parts requiring a deep draw can be easily produced. This hold-down slide is provided with four adjusting screws which are 3½ inches in diameter and have four threads per inch, acme standard. The rock-shafts for operating this slide are of cast steel and have a diameter of 7 inches. The inner slide has an adjustment of 10 inches, the adjustment being effected by two screws that are operated by spur-gears. As these gears have a ratio of 7 to 1, adjustments are easily made. The two adjusting screws are 4½ inches in diameter and have four threads per inch. The entire tensional strain to which this press is subjected when in operation is taken by four 4½-inch tie-bolts that extend through the base casting, the housings and the arch piece at the top. These bolts are



Figs. 1 and 2. Double-action Toggle-motion Drawing Press built by the D. H. Stoll Co.

shrunk in place during the final erection of the press.

The great economy effected by making radiator fronts in three simple operations, namely, blanking, drawing and center hole punching will doubtless induce many automobile manufacturers to adopt the enamelled steel front in preference to the formed and seamed brass ones, now mostly used, owing to the fact that all hand work is eliminated when the former process is employed.

BROWN RADIATION PYROMETER

A new type of radiation pyrometer for use in measuring temperatures beyond the limit of the well-known electric pyrometer with a platinum thermo-couple has been devised by Mr. Richard P. Brown, of the Brown Instrument Co., 311 Walnut St., Philadelphia, Pa. The pyrometer last referred to is very useful for temperatures as high as 2500 degrees Fahrenheit, but above this point the life of the thermo-couple is very short and its accuracy seriously impaired. In the radiation pyrometer the sensitive thermo-couple is located at the rear end of the tube or telescope and a concave mirror focuses the heat rays entering the tube on the thermo-couple, which is connected by wire to the millivoltmeter graduated in temperature degrees. The radiation pyrometer, therefore, has no part directly subjected to the excessive heat to be measured, so that, in consequence, no part is in danger of being destroyed by the furnace gases or high temperatures. This new pyrometer also has the advantage of instantaneous readings, the slightest change in temperature being shown immediately.

Radiation pyrometers heretofore manufactured have been of two types, the adjustable focus and the fixed focus. The imported type with an adjustable focus has been too complicated for general use, and the fixed-focus instruments have had no means for determining whether or not the telescope is too far from the furnace opening or heated body. With

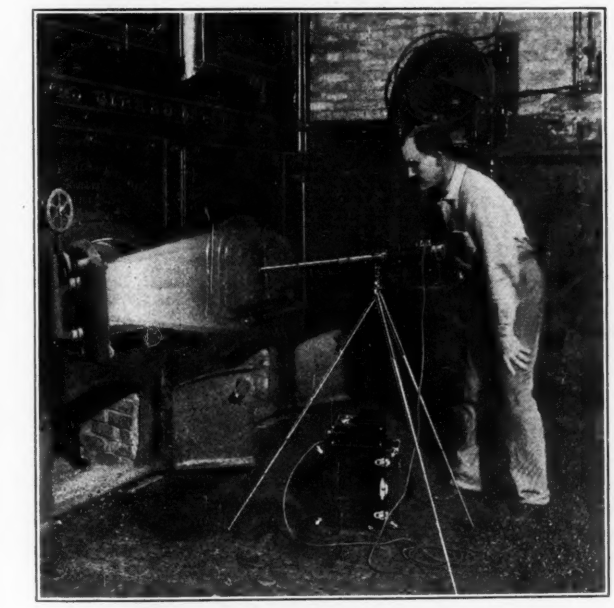


Fig. 1. Brown Radiation Pyrometer Mounted on Tripod

the fixed-focus type, the telescope or tube should not be distant more than ten times the diameter of the furnace opening or body, the temperature of which is being measured. In the new radiation pyrometer, illustrated herewith, which is of the fixed-focus type, a finder, somewhat similar to those used on kodaks, has been placed on the tube, and by means of this finder, the tube can be readily pointed directly at the furnace opening. It also acts as a measure of distances and it is only necessary that the bright red of the furnace opening occupy the whole view in the finder. If some of the dark outside wall of the furnace shows around the bright red opening, this is an indication that the tube is too far distant, and it should be moved closer until only the bright red can be seen. This attachment insures that the tube will always be within the correct distance for obtaining an accurate reading.

It is said that this instrument, under ordinary working conditions, is accurate within 1 per cent or 30 degrees at 3000 degrees Fahrenheit.

Another desirable feature of the Brown pyrometer is the collapsible or telescopic tube which permits the indicator, tripod, tube and wire being placed in a small leather carrying case, which, with the instrument, weighs only 15 pounds.

This instrument is calibrated for measuring the temperature of a black body or the temperature of the walls or parts

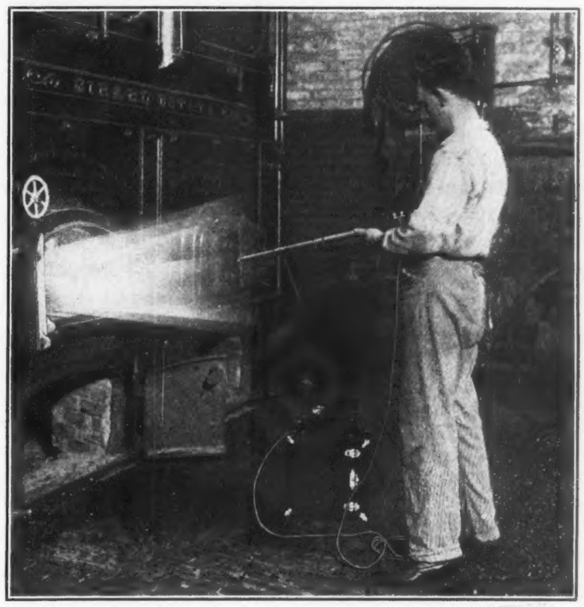


Fig. 2. Method of Using Pyrometer for Obtaining Readings Quickly

inside of furnaces which are practically black bodies. When using the pyrometer for measuring the temperature of molten metals, or highly polished surfaces which reflect, a correction is made. When the pyrometer is being used on a brick kiln or furnace, it is frequently inconvenient, if tests of long duration are to be made, to leave the door or other aperture open. A fire-brick tube is therefore inserted in the opening so that it projects into the kiln or furnace, the inside end of the tube being closed. The pyrometer telescope is then focused on the inner end of the fire-brick tube, and for permanent installation a bracket, bolted to the wall, is used for holding the tube, instead of a tripod.

This pyrometer is particularly adapted for measuring the temperature about a blast furnace plant, in the open-hearth furnaces of steel works, where there are excessive temperatures, in brick kilns for burning fire-brick and refractory materials, in rotary cement kilns where a temperature of about 3000 degrees must be measured 20 feet inside the furnace, and by engineers for testing the temperature of boiler furnaces, or in research work.

GOODYEAR OXY-ACETYLENE EQUIPMENT

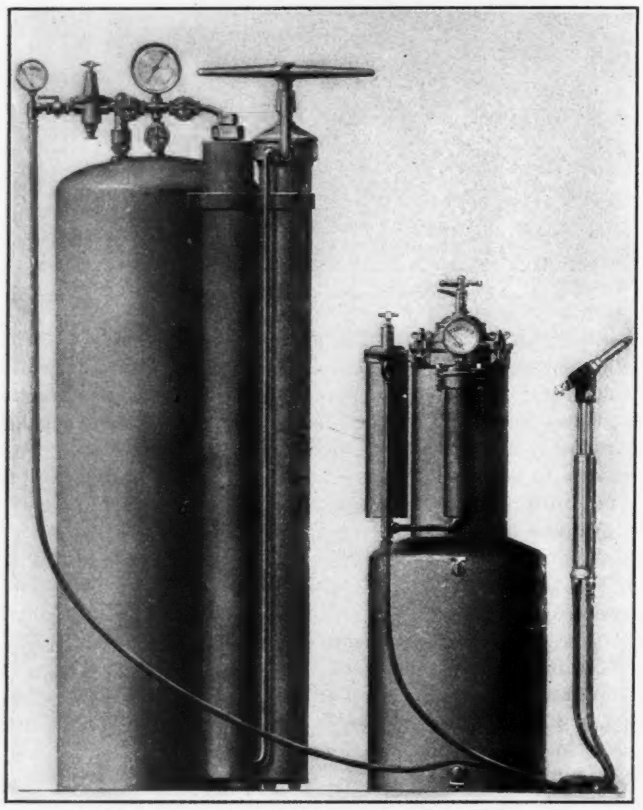
Nelson Goodyear, Inc., 50 Church St., New York City, has designed the oxy-acetylene equipment illustrated herewith in order to provide a simple yet efficient autogenous welding apparatus both for those whose ultimate needs will not be large, and also for concerns who desire a comparatively inexpensive equipment.

The oxygen-producing apparatus, which forms a part of the equipment, obviates the use of a compressor, as the gas is generated in a simple and reliable way to a pressure of 150 pounds per square inch. This oxygen generator which is at the left of the illustration, comprises a generating tower, scrubbing tower, and a storage tank with regulators and gages, as shown. Oxygen is generated from per-chlorate of potash mixed with other ingredients. This mixture is put into a perforated metal cylinder which is placed in the generating tower. To start generation, either a hot rivet or a small quantity of ignition is placed on top of the material; this causes incineration, the entire contents of the perforated basket being slowly consumed. The oxygen is given off

during this incineration, and, as generated, passes through the scrubber in which it is relieved of its impurities, to the storage tank. The manufacturers claim an improvement in this particular, in that there is no expense for heat, as in the case with gas-heated oxygen generators; furthermore, owing to the slow incineration of the material and to the fact that the cylinder containing it does not touch the walls of the generating towers, the excessive expansion and contraction of gas-heated retorts is obviated.

As each pound of the oxygen-producing material generates 5 cubic feet of gas, it will readily be seen that since the basket holds but 10 pounds of material, not more than 50 cubic feet of oxygen can be made at one charge, and hence an unsafe pressure is a practical impossibility. As a precautionary measure, and to conform to the Underwriters' rules, the oxygen storage tank is equipped with a regulator having a relief valve at its lower end. As the foregoing figures indicate, the daily capacity of the oxygen apparatus is 500 cubic feet, if recharged every hour.

In the acetylene generator, which is of a new design, the carbide is fed by means of a diaphragm and a rod passing



Goodyear Oxy-Acetylene Autogenous Welding Equipment

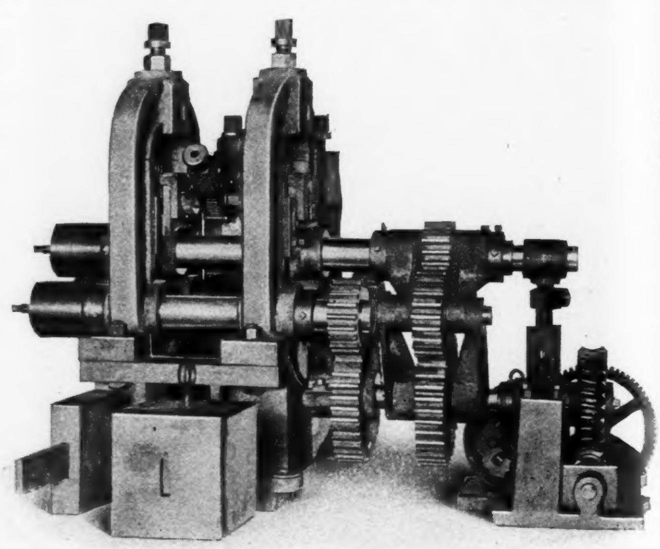
through an annular opening, at the lower end of the carbide chamber. The diaphragm is of rubber, and as rubber is not affected by acetylene gas, its deterioration is very slow. The feed-rod has small recesses in its lower end which fill with the carbide. As the gas is used and the diaphragm falls, the rod with the carbide resting in its recesses, passes through the annular opening; the carbide then drops into the water and the evolution of gas raises the diaphragm, carrying the rod back through the opening, so that it is again filled with carbide and the operation repeated until the charge is exhausted.

It will be seen that the principle employed in this machine is the carbide-to-water principle, which is generally accepted as the best means for generating acetylene, in that the dropping of carbide in small quantities at a time into a comparatively large volume of water, avoids high temperatures within the apparatus. This particular apparatus for feeding the carbide, has two strong advantages in safety: If, for instance, someone about the shop, either from mischief or some other motive, should press down on the adjusting handle at the top of the machine, only about a teaspoonful of carbide could be thus fed, for the evolution of gas would raise the diaphragm above its normal point and a spring would fly out and lock the device against a repetition. In event of the hose being pulled off, the machine would stop operating, for in this case the sudden outflow of gas would exhaust the gas which was under the diaphram so quickly that the feed-rod would fall below its normal point of operation and remain there, the generation of gas under these conditions being too small an amount to raise the diaphragm high enough for the rod to receive its next charge of carbide. This feed-rod is so designed that it will not feed carbide, and hence cannot make gas, at a rate faster than one blowpipe will consume. Thus, it is impossible for this acetylene generator to be run beyond its rated capacity. The generator is designed to supply gas to five different sized tips, and is adequate for all, excepting the very heaviest work. The generator is equipped with a filter and hydraulic back-pressure valve.

As the capacity of the oxygen generating apparatus is sufficient to supply gas for four men, other blowpipes can be supplied by the provision of additional acetylene units, though, of course, if welding operations are to be done at different points in the same factory, it would in that case be advisable, perhaps, to obtain other equipment, comprising both the oxygen and acetylene machines.

MOTOR-DRIVEN BENDING MACHINE

A motor-driven bending machine designed especially for bending the fifth wheels of wagons, but also applicable to the bending of small angles, tees, etc., is shown in the accompanying illustration. This machine consists essentially of the three rolls through which the material to be bent is passed. The bar, angle, or tee, is started edgewise into the rolls, and, in passing through, it is held from slipping to either side by grooves in the rolls from which it emerges in a circular form. By means of a screw in the center of each head, the top roll can be raised or lowered to vary the space between the rolls according to the thickness of the material to be



Motor-driven Bending Machine

formed. After the adjustment is made, the screws are locked with nuts, so as to keep the adjusting sleeve rigid.

All three rolls are positively driven, and by means of ratchets between the two uprights the top roll can be raised instantly for removing a completed ring without touching the screws in the housing. These ratchets operate on cams that allow the raising of the roll for the receiving and extracting of material. This arrangement saves much time and obviates the trouble of adjusting the top screw to bend another ring of the same diameter. The top roll can be put down instantly to its place and is then ready for bending another ring. On the rear of the machine there is a device that makes the first bend in the m tal so that it can be received in the other rolls. This machine is manufactured by the Danville Foundry & Machine Co., of Danville, Pa.

THE GEOMETRIC TOOL CO.'S BOLT THREADING MACHINE

Bolt cutting or threading machinery is ordinarily designed to handle a comparatively rough class of work of such a nature that quantity is of more importance than quality or accuracy. Consequently the average bolt cutter has not been adapted to that class of work which needs to be interchangeable and therefore requires an accurate and uniform thread. In designing the threading machine illustrated in Figs. 1 and 2 it has been the object of the builder, The Geometric Tool Co., of New Haven, Conn., to produce a machine that would have the advantages of the ordinary bolt cutter as to production, combined with the accuracy necessary on interchangeable work.

This machine is simple in construction and contains no parts likely to become deranged. The drive is to a single constant-speed pulley from which motion is transmitted to the spindle through a geared speed change mechanism, giving seven speed variations. The lever by which these speed changes are effected is conveniently placed and it is positively located by the engagement of a spring plunger with the various holes shown. The proper position of this lever for dies of different sizes is indicated on the outside of the casing by the figures 1/4, 5/16, 3/8, 7/16, 1/2, 5/8, 3/4, located above the various holes and representing thread diameters.

The die-head used in this machine is the company's style D type with the exception of certain modifications necessary to adapt it to the changed requirements of operation. The style D die-head was originally designed for use on the turrets of screw machines where the work to be operated upon is rotated and the dies held stationary; therefore to adapt it for use on a rotary spindle the operating mechanism had to be modified and means provided for automatically opening and closing the die while running. The way in which the opening and closing is effected at any predetermined point is indicated at Fig. 2. The yoke by which the die is operated is

Fig. 1. Threading Machine built by the Geometric Tool Co.

attached to a rod that extends beneath the work carriage. On this rod there are adjustable stops which, by engagement with the carriage, operate the die. To facilitate setting the work in correct relation with these stops there is a swinging gage against which the end of the bolt or rod is placed before being clamped in the vise.

A liberal supply of oil is automatically forced to the dies by a small pump located within the column. This pump, as indicated in Fig. 2, is driven by a belt from the main shaft. Beneath the ways of the machine, which are surmounted by a wide channel for catching the lubricant, there is a partitioned reservoir where the chips are automatically separated. The pump takes its supply from the section to the left, into which only clear oil has entered, and forces it through the hollow spindle to the dies. This machine is, of course, adapted to the threading of long bars or rods, as well as bolts and studs. The work itself is held in a strong vise having V-jaws which accurately locate it with reference to the die.

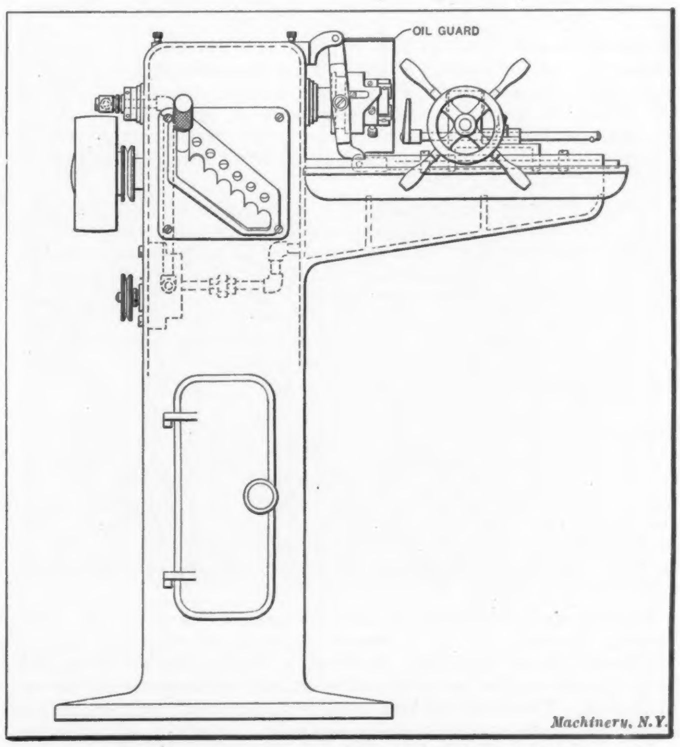
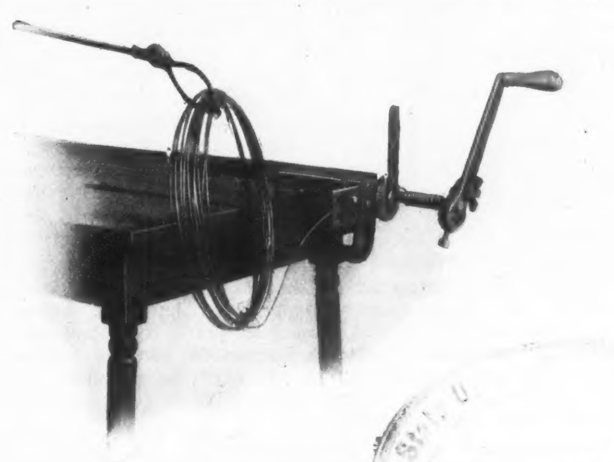


Fig. 2. Elevation of the Geometric Threading Machine

MODEL SPRING WINDER

A spring winder of simple design is shown in the accompanying halftone, which is adapted to the winding of right- or left-hand helical springs of either the extension or compression type.



Model Spring Winder

This machine is so arranged that mandrels for springs of different sizes can easily be placed in position, and means are provided for varying the pitch of the coils.

When a spring is to be wound, the wire is passed through a hole in the tension bolt and then through a slot to a clamp-bolt in the handle. The machine is then ready for operation. The tension is varied by adjusting a winged nut on the tension bolt, and the pitch of the coils is changed by shifting a spacing plate, the position of which is controlled by the handle seen in a vertical position in the illustration. The winder is fastened to a bench or table by means of a thumb-nut and the adjustments are easily and quickly made.

This machine has a capacity for springs varying in size from 1/16 inch to 1½ inch inside diameter, and for lengths ranging from ½ inch to 12 feet. This winder is made of malleable iron with the exception of the working parts which are of machine steel, casehardened. It is intended for use in connection with manufacturing work, repair shops, garages, or, in fact, wherever springs are used.

NEW MACHINERY AND TOOLS NOTES

Center Calipers: William H. Harris, Laurium, Mich. Calipers, the legs of which are linked to a central bar containing a scriber that automatically maintains a central position. This scriber has an in-and-out adjustment against the tension of a spring, and it may be used for locating the center of any part within the capacity of the caliper.

Pipe Wrench: Wright Wrench & Forging Co., Canton, O. Quick-acting pipe wrench which can be adjusted instantly to any size pipe with one hand. This wrench has a capacity for pipes ranging from ⅛ inch to 1½ inch in diameter. The mechanism is simple and the grip on the movable jaw interchangeable, so that it can be easily replaced when worn.

Wrench: Detroit Model Machine Works, Fremont, Ohio. Quick-acting wrench having an adjusting nut, the diameter of which is greater than the width of the bar (which is threaded only on the lower side), so that it can be quickly disengaged when making an adjustment. This disengagement is effected by pressing the sliding jaw and nut downward against the tension of a spring.

Machinists' Hammers: Van Doren Mfg. Co., Chicago Heights, Ill. New line of drop-forged ball-peen hammers. These hammers are forged from high-grade tool steel and are carefully hardened. Particular attention has been given to the weight which is within ¼ ounce of the nominal weight. The handles are of second-growth hickory of good quality, and the hammers are well-balanced.

Extensometer: Riehle Brothers Testing Machine Co., Philadelphia, Pa. Extensometer for tension tests in which the test piece is clamped between four pointed thumb-screws, contained in two yokes that are held apart by a connecting-bar or rod. The upper yoke is hinged to this bar, and by means of a lever construction, the deformation of the piece is doubled in the reading of the micrometer, as the latter indicates twice the extension of the test piece.

Geared Head Lathe: Hamilton Machine Tool Co., Hamilton, O. Lathe with single constant-speed driving pulley and all-geared head. The spindle of this machine can be stopped instantly from any point along the bed by operating a shifter-rod which connects with a friction clutch in the head. There are twelve changes of spindle speeds in all, six being obtained by the operation of a lever at the front of the head, which number is doubled by the back-gears. The sliding gears are of steel and run in an oil bath.

Tilting Shaper Table: Mark Flather Planer Co., Nashua, N. H. Combination tilting and swiveling shaper table which permits angular adjustment of the work to be made about axes parallel to or at right angles with the face of the column. The tilting table rests on the regular table which has lugs that form the bearings. The adjustments are effected by conveniently located screws which have thrust blocks to prevent end play. The limit of angular movement is 5 degrees below the horizontal and 8 degrees above it.

Pyrometer: Price Electric Co., Lakeview, Cleveland, O. Recording pyrometer the recorder of which is equipped with a roll of graduated chart paper which, by suitable means, is moved beneath a needle. The recording line is made by an electric spark which jumps from the end of the pointer and perforates the chart at regular and frequent intervals. The couple or business end of the pyrometer generates an electric current, the intensity of which is proportional to the difference in temperature between the ends.

Sheet-Metal Squaring Shear: Niagara Machine & Tool Works, Buffalo, N. Y. Power sheet-metal squaring shear equipped with an automatic feed which locates the stock in the proper position for cutting strips in any desired width up to 12 inches. The gripping mechanism is mounted on a slide the stroke of which can be readily adjusted for strips of different widths. This machine is back-geared with a ratio of 4 to 1, and the speed of the slide is 46, 60 and 80 strokes per minute, the slowest speed being used for the widest strip.

Graduating Machine: Modern Tool Co., Erie, Pa. Universal graduating machine which automatically stops when the work is completed. This graduating machine is made in two sizes, designated as Nos. 1 and 2. The smaller size is intended for light work, such as curved scales, surveying instruments, etc., while the No. 2 machine is adapted to the graduating of heavy milling-machine saddles, the faces or edges of disks and similar work. Means are provided for accurately adjusting all parts, and any width of spacing or length of line can be obtained.

Tumbling Barrel: Globe Machine & Stamping Co., Cleveland, O. Horizontal tumbling barrel for burnishing articles prior to plating and for polishing either plated or unplated parts. The burnishing is effected by the use of steel balls. The barrel is of cast iron lined with maple wood and has an octagonal cross section. These machines are made with three sizes of barrels, the smallest of which is 24 inches in diameter by 8 inches wide, and the largest 30 inches in diameter with a width of 16 inches. They are also furnished in either the single-, double-, or triple-barrel types.

Chain Hoist: Chisholm & Moore Mfg. Co., Cleveland O. Forty-ton chain hoist, the design of which is similar to that of smaller sizes made by this company. It has a multiple disk brake which effectually locks the load and at the same time permits free lowering by a reverse movement of the hand-wheel. There are two independent load chains which move together; the idler sheaves are placed so as to permit doubling up the chains and carrying the load on eight strands of ¾-inch chain. These hoists are also made in three smaller sizes having capacities of 16, 20 and 30 tons, respectively.

Hack-saw Machine: Massachusetts Saw Works, Chicopee, Mass. Power hack-saw machine with capacity for cutting stock up to 6 inches in diameter. The machine stops automatically and requires no attention after the cut is started. It has an adjustable stop so that cuts can be made to any desired depth. There is a rest for the piece being severed which prevents the breaking of blades when the severed part falls. By means of a patent adjustable lifting device, the blade can be raised on the return stroke, which greatly prolongs the life of the saw. This machine has a steady, even, forward stroke and a quick return stroke.

Variable Speed Planer: Hamilton Machine Tool Co., Hamilton, Ohio. Variable speed driving mechanism for the planer, by means of which four cutting speeds are obtained. These speed variations are controlled by a single lever located just back of the driving pulleys. The planer has a constant quick return speed. All gears are of steel and are engaged by direct contact and not by clutches. The speed change mechanism is located in the bed where it is out of the way and thoroughly protected. The different speeds available and the proper location of the levers for each speed is indicated by an index plate attached to the machine.

Core Machine: Brown Specialty Machine Co., Chicago, Ill. Core-making machine of the same general type as formerly manufactured by this company, but with the addition of back-gears which give a ratio between the driving shaft and the bit of 3 to 1. These back-gears are employed when making cores larger than 3 inches, a direct drive being used for cores under this size. This machine has a capacity for diameters ranging from ⅜ inch to 7 inches, and for square cores with widths ranging from ⅜ inch to 5 inches. By the use of special dies, round cores as large as 11 inches in diameter can be made, and square ones with widths up to 7½ inches.

Wheel Lathe Dog: Putnam Machine Co., Fitchburg, Mass. Dog for locomotive driving-wheel lathes; this dog has serrated jaws which move along inclined planes and are wedged against the tires, thus giving a powerful drive. When the wheels are in place, the jaws which are held in a retracted position by latches are released so that they come in contact with the tires. Opposite each jaw there are clamps which give a rigid support to the wheel. When the lathe is started and the rotary motion of the wheels tends to be retarded by the resistance of the cut, the jaws move slightly along the inclined planes and the serrations are embedded into the tires, thus giving a strong grip.

Power Press: Niagara Machine & Tool Works, Buffalo, N. Y. Double back-geared power press equipped with an automatic friction clutch designed for handling heavy work. In the operation of this clutch no drop weight is used as it is thrown into engagement by a positive mechanism consisting of a series of links and levers which cause it to be fully engaged before the press begins to work. The clutch can be tripped either by a foot-treadle or by hand. When the foot treadle is used, motion ceases at the highest point of the stroke, whereas, by the use of the hand lever, the machine can be stopped or started at any point. The distance between the uprights of this machine is 28 inches, the ratio of gearing is 25 to 1.

Wrenches: Bemis & Call Hardware & Tool Co., Springfield, Mass. A new line of screw wrenches designated as "No. 60 Steel Handle" and "No. 62 Screw Wrench," built in sizes ranging from 6 to 21 inches. The bars of both styles are forged from special open-hearth steel, and the slides which are of a tough semi-steel, are of a strong design. The operating screws are of a high-grade steel. The handle of the No. 60 style is of semi-steel, hollow, and well-braced internally. It is forced on the shank under considerable pressure and is securely riveted at the tip, being also held with a lateral pin rivet. On the No.

62 style, the handle consists of a frame, which has selected hardwood sides that are locked in place under pressure and securely riveted. The frame itself is also rigidly attached to the wrench bar.

Molding Machine: E. Killing's Molding Machine Works, Davenport, Iowa. Molding machine of the jarring power rockover type. When the machine is being operated, the pattern is mounted on a pattern board and the whole is fastened to the rockover table. After the flask is in place and filled with sand, the mold is jarred to the proper density by compressed air which is alternately applied and released automatically in the cylinder under the jarring table. Air is employed for this purpose and the pattern may be withdrawn at the speed which will give the best results. The jarring cylinder and the valve are simple in construction and the latter is of the expanding ring piston valve type. No springs are used on this machine and all working parts are protected against the abrasive action of the sand.

Vertical Milling Machine: Newton Machine Tool Works, Inc., 24th and Vine Sts., Philadelphia, Pa. A heavy design of vertical milling machine. The drive is by belt to a horizontal shaft at the top of the column which transmits movement to the spindle through a large worm-wheel fitted with roller thrust bearings. This worm-wheel has a bronze ring with teeth of steep lead and both the driving worm and worm-wheel are entirely encased, permitting continuous lubrication. All gears in the machine are of steel or bronze and all movements are clutched. The circular table is 60 inches in diameter and it has a large central bearing in the supporting saddle. The maximum distance from the end of the spindle to the table is 22 inches; length of the cross and longitudinal feeds 33 inches, and the distance from the center of the spindle to the upright, 34½ inches. The extreme height of the machine, with the spindle in its highest position, is 12 feet 6 inches.

Molding Machine: Osborn Mfg. Co., Cleveland, O. "No-shock-jolt" molding machine, which is mounted upon a heavy cast-iron bed-plate that acts as a shock absorber. To prevent any transmission of the shock from the bed-plate to the foundation, the former is mounted upon four steel springs that are similar to those used in freight car construction. There is also another set of lighter springs above the bed-plate which prevents any rebound and consequent loosening of the sand in the mold. Thus the weight of the mold, machine, and bed-plate, is held in suspension between two sets of springs which, in conjunction with the weight of the bed, absorb the blows required to pack the sand. One advantage of this construction is that a large foundation is unnecessary. In starting the machine, it is simply necessary to fill the flask and then set the machine in motion. The stroke can be varied while running, by regulating the compression, while the quantity of air admitted to the cylinder takes care of molds of varying weights.

* * *

ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The thirty-second annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York, beginning Tuesday evening, December 6, which will be the occasion of the annual presidential address and of a reception by the president and president-elect. The professional papers to be presented are unusual in variety and merit. A variation in the usual program has been introduced in the time of engineering excursions. These will be on Friday after all the professional papers have been presented. Members will be able to attend all of the sessions and still not miss one or more of the excursions in which they are interested. Following is the list of papers, subject to change and addition:

"The Transmission of Heat in Surface Condensation," by George A. Orrok.

"Combustion and Boiler Efficiency," by Edward A. Uehling.

"Automatic Control of Condensing Water," by B. Viola.

"Test of a 10,000-K.W. Steam Turbine," by S. L. Naphtaly.

"Test of a 9,000-K.W. Turbo-Generator Set," by F. H. Varney.

"Notes on the Value of Napier's Coefficient with Superheated Steam," by Isaac Harter, Jr.

"A New Theory of Belt Driving," by Selby Haar.

"Stresses in Connecting-Rods," by W. H. Herschel.

"Operating Conditions of Passenger Elevators," by Reginald Pelham Bolton.

"Modern Shoe Manufacture," by M. B. Kaven and J. B. Hadaway.

"The Field for Grinding," by C. H. Norton.

"Precision Grinding," by W. A. Viall.

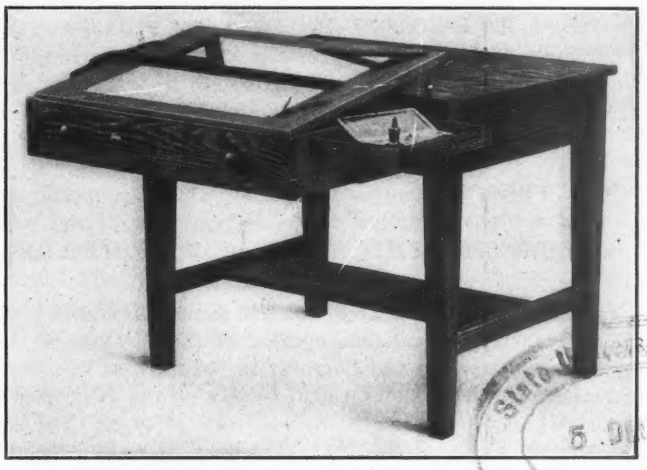
"Modern Grinding Methods," by B. M. W. Hanson.

"First Large Gas Engine Installation in American Steel Works," by E. P. Coleman.

"Industrial Continuation Schools of Munich," by Dr. George Kerschensteiner, superintendent of schools, Munich, Bavaria.

COMBINATION DRAFTING AND OFFICE TABLE

A combination table which may be converted from a library or office table into one suitable for drafting is shown in the accompanying half-tone. As the engraving indicates, this table is arranged for drafting purposes by simply pulling out the drawer and placing the rear part of a drawing-board, which is set in the top of the drawer, on the table. The drawing instruments and other paraphernalia can be kept in a small drawer or tray that is inserted in the side of the main drawer.



Office or Library Table with Drawing Board ready for Use

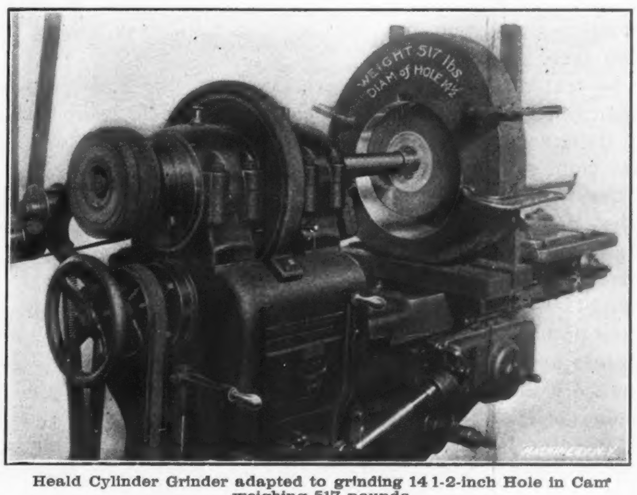
The space beneath the board can be utilized for drawing paper, books, etc. It will be noted that the drawing-board can be placed in the working position without disturbing whatever might be kept on top of the table.

This table is made of thoroughly kiln-dried oak and it has a golden oak polished finish. It is manufactured by the Fritz Mfg. Co., Grand Rapids, Mich.

* * *

GRINDING LARGE HOLES IN CAMS ON THE HEALD CYLINDER GRINDER

The accompanying illustration shows the cylinder grinder built by the Heald Machine Co., Worcester, Mass., grinding a 14½-inch hole in a cam weighing over 500 pounds. Although designed primarily for internally grinding automobile and



Heald Cylinder Grinder adapted to grinding 14 1-2-inch Hole in Cam weighing 517 pounds

other gas engine cylinders, it is an adaptable machine suited to varied classes of grinding. The illustration shows the special adaptability of the machine to pieces for which machines of the revolving work type are not well suited. This machine is of the sun-and-planet or universal type, the spindle being mounted in an eccentric bushing in a revolving head, with means for changing the amount of the eccentricity and thus controlling the size of the hole ground (see MACHINERY, August, 1905, for illustrated description). The job called for grinding out the shaft bore of two cams for a large shaft of a drawing press of massive proportions. When the press was being assembled at its destination it was found that the holes in the cams were too small to allow them to go on to the shaft

in the proper place, and about 0.025 or 0.03 inch had to be removed before they could be assembled.

The cams were mounted on parallels on the table of the grinder and brought into position against an angle-plate with the hole parallel with the grinding spindle and the travel of the table. Owing to the large diameter of the hole, it was necessary to secure a specially large grinding wheel for the job, which, in turn, necessitated a relatively large driving pulley mounted on the left-hand end of the wheel spindle, to produce the correct circumferential work speed. This feature alone, perhaps, illustrates the extreme capacity of the machine, inasmuch as the pulley commonly used is still in place, the wooden pulley having been mounted outside, as will be seen by noting the dark ring showing the edge of the pulley rim. This pulley is the one on which the belt ordinarily runs when grinding automobile and gas-engine cylinders, and is in proper proportion to the diameter of the grinding wheels used in that particular work.

* * *

APPRENTICESHIP THE BASIS OF TRADE TRAINING

That apprenticeship is a vital part of industrial training was the substantially unanimous opinion of the speakers on the topic "Apprenticeship and Corporation Schools," at the fourth annual convention of the National Society for the Promotion of Industrial Education held in Boston, Nov. 17 to 19. The subject named was considered in a series of papers presented Friday morning, Nov. 18, and the papers and discussions of the afternoon session of that day, although not confined to that specific topic, tended to emphasize still more strongly the fundamental necessity of providing for some form of apprenticeship in connection with all schools undertaking to train young boys in mechanical trades.

In opening the sessions of the day, Magnus W. Alexander, of the General Electric Co., Lynn, Mass., who presided at the morning session, sketched the transition from the medieval apprenticeship system to the new apprenticeship idea that arose when the use of power machinery had seemed for a time to destroy both the need and possibility of apprenticeship. That training under some form of apprenticeship system which would be adapted to the manufacturing conditions of the present was indispensable, had been recognized, Mr. Alexander said, by the majority of manufacturers. The present problem, therefore, was not whether there should be an apprenticeship system, but what kind of an apprenticeship system there should be.

Several different ways of working out this problem were described in formal papers which showed considerable variety in the manner of attacking the problem, but were alike in the one point of being based upon apprenticeship.

Tracy Lyon, of the Westinghouse Electric & Mfg. Co., Pittsburg, described the system employed by them, by which the trades' apprentices in the shops are instructed in the classroom four hours a week during the entire year, and are there taught mechanical drawing and arithmetic in the shape of shop problems. The main object is to awaken the boys' intelligence and to set them to thinking in an accurate way about the work they are doing in the shop; the final object being to make good, all-around mechanics of them. The present plan of teaching is to ground the boys thoroughly in the construction and use of a standard machine tool, a lathe, for instance, then send them into the shop to gain a certain amount of experience in the operation of this tool, and after this is acquired to bring them back and repeat the process with another tool. During their entire apprenticeship the boys are under the supervision of the foreman of the apprenticeship department, who keeps a record of the work and the progress of each one. A night school with very elaborate technical equipment has been provided for the adult workmen of the shops and this night school is also open to the boys so far as they are qualified and wish to broaden and advance their studies.

The notably successful apprenticeship system of the Atchison, Topeka & Santa Fe Railway System, Topeka, Kans., was described by F. W. Thomas, supervisor of apprentices for the Atchison Co. In these schools of the Atchison system, apprentices in the shops are taught as individuals according to their individual needs and capacities so as to make them better understand the work they are called on to do in the shops; the lessons are simple and each lesson refers to some part of a locomotive, car, shop tool or other feature common to railroad work. The function of the school-room and of the apprenticeship instructor is not only to teach the boy things, but to teach him to use his brains along with his hands and eyes, to reason out and to understand the work in the shop as he progresses. Although the Santa Fe is spending between thirty-five and forty thousand dollars a year in training boys for its future needs, Mr. Thomas declared that as a result of the instruction given to them the boys are accomplishing enough more work to more than pay for the cost of the teaching.

The methods of the Mechanics School of the Solvay Process Co., Syracuse, N. Y., were presented by George G. Cotton. The work of the mechanics of this company is repair work on the company's plant, and it requires the services of mechanics who have been trained in the special chemical work of the company. Employes obtained from the usual sources are lacking in the necessary special knowledge and must undergo a course of preliminary training in the company's shops before they can be used on regular work. The method of the school is substantially the original "Cincinnati Plan" of one week in the shop, one week in the school. The boys alternate week and week between the shop and school, the shop squad following the regular shop schedule of hours and the school squad attending from 8 a. m. to 3 p. m., with a noon recess. The boys are paid for their time both in the shop and in the school. All shop work is carried on in the shop, under shop conditions and management and always on the regular work, which work requires speed, accuracy and results. The character and ability of each boy is taken into account, and he is considered to have completed his course when he shows that he is properly prepared for the work for which he is being trained; he is then graduated into the regular shop employ. The boy's advancement in pay depends entirely upon his industry and ability.

Another type of trade school was described by Samuel F. Hubbard, superintendent of the North End Union School of Printing in Boston. This school depends finally upon a group of employing printers who are associated with the management and direction of the school and who provide the boys with the opportunity for further training and with wages by taking them into their shops as apprentices after the period of preliminary training in the printing school. Mr. Hubbard stated very forcibly the value of necessity of apprenticeship as a means of providing the partly taught boy with regular wage-producing work and thus saving him from the only too probable disasters that follow the hunting of a job by untrained or half-trained youngsters.

In summing up the morning's discussion, G. M. Basford, assistant to the president, American Locomotive Co., New York City, pointed out the fact that in all the schemes described, there was either an actual apprenticeship or some relation between the company and the boy that was pretty nearly the same as apprenticeship. Mr. Basford asserted that an apprenticeship is apparently the only way of securing for boys in trade schools the shop atmosphere and the familiarity with shop conditions which is necessary to make them efficient mechanics.

At the afternoon session of November 18 a very striking report was the paper of Frank B. Dyer, superintendent of schools, Cincinnati, on the Cincinnati Public Continuation School for apprenticeship in mechanical trades. Machine apprentices spend four hours a week in this school and the results in improved efficiency of these apprentices in the shops has been a very remarkable product of a system which has cost the city only $3000. The plan of the continuation school has proved as stimulating to the older workmen in the machine shops, and the industrial night schools have as a result proved attractive to these older men.

EDUCATION AND THE DEVELOPMENT OF THE APPRENTICE*

The various methods for securing an ample supply of skilled labor were discussed in this paper and the main point urged was that the employers and the school boards come together and organize industrial and trade preparatory schools as a part of the public school system.

Prof. Flather believed that general instruction on manual training would not need these requirements, from the limitation of its work; for with but few exceptions, the time devoted to any one subject does not exceed 250 hours and when it is considered that from 8,000 to 11,000 hours are spent in learning a trade, it can be readily seen that the manual training of our schools can have but little weight. The one marked advantage that it has, however, is the opportunity of affording teachers and parents as well as the boy, knowledge as to whether or not an industrial career should be followed.

Prof. Flather further pointed out that it is due to the democratic ideas held by our school boards that there has been so little differentiating in the courses. This should not be, for the same conditions exist in the status of our school children as in the commercial and business world, where it is recognized that all men are not equal.

It was urged that manual training be taught in the elementary schools up to the end of the sixth grade, when separate courses should be established, one, as at present, for professional and commercial training, as well as the higher technical training leading through the high school, and the other having in view the industrial training of the pupil. During the seventh and eighth grades of this industrial training, practical work should predominate, though the training should be general and not specific. During this period the school day might be increased to seven hours, to compensate for the decreased amount of study preparation. Of this amount, at least four hours should be devoted to practical work under skilled workmen.

Following this should be two years of specialized trade-preparatory work in which the time spent is devoted to one definite trade, to the end that by judicious and intelligent training the boy may enter some industry where he will be given an opportunity, at fair wages under an apprentice instructor, to finish the trade begun in the preparatory school.

Here, the time could be increased to eight hours a day with four hours on Saturday, throughout eleven months of the year. An advisory committee of representative men, selected from the leading industries of the locality, could cooperate as an advisory committee in this course. It could not be expected that all the boys would become skilled tradesmen, but the training could well be adapted to prepare all boys who so desired to enter industrial pursuits, and, by a process of elimination, those best qualified could be trained for the trades, while others of less promise could be trained for some special work. At any rate, the amount of time required to finish a trade might thus be materially reduced.

It was further pointed out by Prof. Flather that no universal system of trade education is applicable, but local conditions will suggest and demand modifications. It should also be borne in mind, in working out such a course of study, that some of the boys will reach a period in their life when they will want to keep on with their studies and enter a technical college. For these, provisions should be made, by modification of the high-school course with this in view. It is believed that this system will further the interests of both employers and employes, making for better citizenship and a more rapid development of our American industries.

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The pneumatic tool-holder for locomotive tire turning described in the October number on page 133, engineering and railway editions, by "Canadian Pacific Railway Apprentice," has been patented by W. Petersen, shop engineer of the Canadian Pacific Railway, Patent No. 971556.

* Abstract of paper by. J. J. Flather, read before the National Foundrymen's Association, Chicago, Ill., November 17, 1910.

AMERICAN MUSEUM OF SAFETY OPENING

A permanent exhibit of safety appliances of the American Museum of Safety at the United Engineering Societies' Building, 29 West 39th St., New York, was opened November 21 with appropriate exercises in the auditorium. The gold medal offered by S. C. Dunham, president of the Travelers' Insurance Co. was presented to the United States Steel Corporation as being the concern that has done most for the protection of its workmen by the adoption of safety devices, etc. The medal was accepted by W. B. Dickson, first vice-president of the corporation.

The *Scientific American* gold medal for the best safety device exhibited at the museum was awarded to the Safety Scaffolding Co., of New York for its suspended platforms. Dr. W. H. Tolman, director of the museum showed his collection of lantern slides illustrating safety appliances in use abroad and in America.

The permanent exhibition of the museum is on the sixth floor of the Engineering Societies' Building where a good-sized room is filled with devices for promoting safety of life and limb. The museum is badly in need of funds for carrying on its humanitarian work, and a plea was made at the meeting for $25,000 to meet the need for expansion.

* * *

The running time between New York and Philadelphia on the New Jersey Central Railroad has been considerably shortened, it having been cut down to 1 hour and 50 minutes on all through trains between the two cities in both directions. As the trip between New York and Philadelphia includes a ferry transfer between Jersey City and New York with consequent delay, the actual running time for the 90 miles between Jersey City and Philadelphia will be only 96 minutes, including on some of the trains as much as twelve minutes for delays and stops. On some stretches, therefore, a speed of 90 miles per hour will be maintained, and the average speed, stops and slow-downs excluded, will be over 64 miles per hour. The service from Jersey City to Philadelphia will be the fastest hourly train service in the world.

* * *

Don't try to file a hardened mandrel.

Don't caliper a piece of work when it is running.

Don't make double lines when laying out die work.

Don't use a micrometer on work that has scale on it.

Don't make tight and loose pulleys the same diameter.

Don't use a three-foot pipe on a 12-inch monkey-wrench.

Don't resort to a triangular file to doctor up a poor thread.

Don't think your tool kit is complete without an oilstone.

Don't grind a right-hand tool to make it do a left-hand tool's work.

Don't use a soft oilstone to put an edge on a sharp-pointed tool.

Don't make punches a loose fit for blanking or piercing thin metal.

Don't take a heavy chip for a finishing cut when turning threads.

Don't think that all machinists are "mechanics," for they are not.

Don't forget that you can file an emery wheel with a common file.

Don't hit a hardened die or any hardened work with a steel hammer.

Don't use fatty oil on an ice machine, where ammonia will get at it.

Don't use lard oil when cutting cast-iron threads; kerosene is better.

Don't think that weight necessarily means value in a machine tool.

Don't use a hardened steel hammer to drive arbors out of or into work.

Don't try to force a screw into a hole when it is not properly fitted.

Don't make punches a tight fit for blanking or piercing thick metal.

Don't use a tool with too broad a nose for finishing small steel parts.

PERSONALS

Robert R. Keith, for five years mechanical engineer and general superintendent of the Sight Feed Oil Pump Co. of Milwaukee, Wis. and The Richardson-Phoenix Co., its successor, has resigned and is now on a Western vacation trip, taking a short rest before resuming his activities.

Robert Wilde, foreman of the gear cutting department of the Cadillac Motor Car Co., Detroit, Mich., by which concern he was employed for eight years, has resigned his position to become superintendent of E. J. Kruce & Co., Detroit, manufacturers of transmission gears and auto parts.

J. M. McDowell, formerly president and manager of the Russell Drill Chuck Co., is now associated with the Morrow Mfg. Co., Elmira, N. Y. in the capacity of general sales manager of the drill chuck department. Mr. McDowell's long experience in the manufacture of drill chucks qualifies him as an expert in that line.

Fred H. Moody, formerly associate editor of *Canadian Machinery*, Toronto, Ont., has joined the staff of MACHINERY. Mr. Moody is a graduate of the mechanical engineering course of the University of Toronto, and has had the practical shop and drafting-room experience that well qualifies him for editorial work on this journal.

Walter Brinton, superintendent of the manganese steel department of the Taylor Iron & Steel Co.'s plant at High Bridge, N. J., since 1895, has resigned and has taken a position as consulting engineer for the Edgar Allen American Manganese Steel Co., manufacturers of manganese steel at Chicago Heights, Ill., and at New Castle, Del. Mr. Brinton's headquarters will be at the New Castle plant.

Fay L. Faurote, advertising manager of the E. R. Thomas Motor Co., Buffalo, N. Y. has resigned to become associated with a large corporation in Chicago. Mr. Faurote is a graduate of the University of Michigan, class '03 with degree of M.E. and has specialized in gas engine work. He has been actively engaged in publicity work, and is the author of three books on automobiles and gas engines.

John I. Rogers has opened a New York office in the City Investing Building, 165 Broadway, which will henceforth be used as his main office. Mr. Rogers makes a specialty of forging by the steam hammer, the drop hammer and the hydraulic press; special rolling such as railway tires and rolled wheels; the use and manufacture of alloy steels; machine shops and power plants; and general iron and steel works engineering. He resigned from the Midvale Steel Co. of Philadelphia about one year ago to take up professional practice, and since has been engaged in consultation work and design along the above lines.

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OBITUARIES

Philip Corbin, president of the American Hardware Corporation and founder of P. & F. Corbin, died at his home in New Britain, Conn., November 3, aged eighty-six years.

Prof. Stillman W. Robinson died at his home in Columbus, Ohio, October 31, aged seventy-two years. He was the author of technical books, including "Principles of Mechanism."

Rawson Hathaway died October 23, aged eighty-two years. Mr. Hathaway worked for thirty-three continuous years, and after a short break, for seven more years at the United States Armory, Springfield, Mass.

Edmund S. Shepardson, formerly superintendent at the L. S. Starrett Co.'s factory in Athol, Mass., died October 29 at his home in that place after a year's illness, aged sixty-two years. Mr. Shepardson had been in the employ of the company for twenty-eight years.

Willard Steven Whitmore, inventor of the papier-mache matrix process of stereotyping used by nearly every newspaper in the country, died in October at his home in Washington, aged sixty-eight years. Mr. Whitmore held a position as stereotyper in the government printing office. It is said that he never received any material benefit from his very valuable process.

Octave Chanute, a distinguished engineer whose early investigations of mechanical flight and writings on the theory of air-supported planes perhaps justly entitled him to the appelation "father of the aeroplane," died at his home in Chicago November 23, aged seventy-eight years. Mr. Chanute was born in Paris, France, and came with his parents to America when only six years old. He achieved eminence as a railroad engineer and at one time was chief engineer of the Erie R. R. He was builder of the Kansas Pacific Railway, the Union Stock Yards of Chicago and the Missouri River Bridge. His writings on mechanical flight were not recognized as authoritative or of importance until Orville and Wilbur Wright had made their first successful flights and had acknowledged that it was Chanute's book "Progress in Flying Machines," published in 1894, which had turned their attention toward aeroplane experiments. They gave him credit for working out the theory of design of aeroplanes and blazing the trail for a practicable machine. Chanute's prestige as an aerial authority is even greater in Europe than in this country.

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COMING EVENTS

December 5-6.—Annual meeting of the American Society of Refrigerating Engineers, New York. W. H. Ross, secretary, 154 Nassau St., New York.

December 6-9.—Annual meeting of the American Society of Mechanical Engineers, 29 W. 39th St., New York. Calvin W. Rice, secretary.

December 12-15.—Convention of the National Gas and Gasoline Engine Trades Association, Racine, Wis. Albert Stritmatter, secretary, Cincinnati, Ohio.

December 31-January 7.—International Automobile Show, Grand Central Palace, New York.

January 7-21.—Association of Licensed Automobiles tenth annual exhibition of automobiles and automobile appliances. M. L. Downs, 7 East 42d St., New York.

NEW BOOKS AND PAMPHLETS

THE INVOLUTE GEAR SIMPLY EXPLAINED. 41 pages, 6 x 9 inches. 35 illustrations. Published by The Fellows Gear Shaper Co., Springfield, Vt., for free distribution.

This interesting pamphlet is a "direct, concise treatise, which makes plain the action of involute gearing, and yet avoids the use of higher mathematics." It is written by one who has made a study of gearing and gearing problems and is expressed in the simplest language, with diagrams to illustrate. Any mechanic or student interested in practical gear making and the theory of involute gear action will do well to get this pamphlet and study the principle of the involute and its application in the design of that interesting machine, the Fellows gear shaper.

THE VOLATILE MATTER OF COAL. By Horace C. Porter and F. K. Ovitz. 56 pages, 6 x 9 inches. Published by the Bureau of Mines, Department of the Interior, Washington, D. C., as Bulletin No. 1.

This bulletin is issued by a new bureau in consequence of the various fuel investigations that were being carried on by the technologic branch of the United States Geological Survey being transferred by law on July 1, 1910, to a new federal bureau, the Bureau of Mines, which was authorized to continue the investigations, and make public reports of the results. The bulletin is a report on an investigation of the volatile matter in several typical coals—the composition and amount at different temperatures of volatilization. It is merely a preliminary report, stating the problems studied, the methods used, and the results thus far obtained, as the experimental work is still in progress.

EFFECT OF KEYWAYS ON THE STRENGTH OF SHAFTS. By Herbert F. Moore. 26 pages, 6 x 9 inches. Published by the University of Illinois, Urbana, Ill.

This is Bulletin No. 42 of the University of Illinois Engineering Experiment Station, and gives the results of a series of tests recently carried out on the effect of keyways on the strength of shafts. This set of experiments was planned and conducted with the realization that, while the strength and proper proportion of keys have been the subject of considerable study and some experimentation, the effect of the keyway on the torsional strength of the shaft has apparently been studied but little, though it had been generally conceded that the keyway must weaken the shaft in which it is cut. The effect of combined bending and twisting was also the subject of experiments. For comparison of the shaft before and after keyseating, the ratios of the strengths are used as in riveted joints, and spoken of as "the efficiency."

MECHANICAL WORLD POCKET DIARY AND YEAR BOOK FOR 1911. 423 pages, 4¼ x 6¼ inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price 6d. net.

The twenty-fourth annual edition of this handy book has just been issued. It contains the usual information, gotten up in convenient form, for ready reference, and has been enlarged by the addition of thirty-four pages. It is a much thicker book than the last issue, not being printed on as good a quality of paper, which materially detracts from its value as a reference. There are the usual chapters on steam and its properties, steam engines, indicators, steam turbines, boilers, gas and oil engines, producers, beams and girders, shafting, gearing, belting, cutting tools, ball-bearings, and numerous standard tables of weights, measures, etc., and serves as a very good guide for general purposes. Considering the small price it is a remarkable book, and few having need of the data contained can afford to be without it.

CONCRETE WALL FORMS. By A. A. Houghton. 62 pages, 5 x 7¼ inches. Published by Norman W. Henley & Son, 132 Nassau St., New York. Price, 50 cents.

This is number one of a series called "Concrete Workers' Reference Books," all written by the same author. Mr. Houghton prepared this work, realizing that with the increasing demand for monolithic walls instead of block construction, such a treatise was needed by the worker who constructs the forms or centering for this work. Simple but effective methods of bracing wooden forms, as well as many styles of easily made wall clamps, separators, and wire ties, are described, all calculated to save expense of construction. A hopper described herein makes the rapid placing of the concrete a simple matter. The placing of doors, window frames, etc., is also dealt with, and many other valuable ideas illustrated and described in the simplest possible language to be readily intelligible by all concrete workers.

CONCRETE FLOORS AND SIDEWALKS. By A. A. Houghton. 63 pages, 5 x 7¼ inches. Published by Norman W. Henley & Son, 132 Nassau St., New York. Price, 50 cents.

Number two of the series of "Concrete Workers' Reference Books," written by Mr. Houghton, has this title, and is a reference book, written in simple but forceful language to meet the requirements of those for whom it was especially intended. The writer has not only treated of the subject of molding concrete floors and sidewalks comprehensively, but has gone into the production of the more ornamental effects made possible by employing mosaic concrete floor tile. The rules of construction are taken up in regular order, as the work should progress, treating of the essential points on foundations and the plac-

ing of the forms, as well as materials, proper proportioning and mixing, placing and tamping, size of slabs, joints, and finishing the surface. Causes of defects are also outlined. More detailed work on floors and sidewalks is gone into, but the above gives the essential points of the book.

DESIGN OF MARINE MULTITUBULAR BOILERS. By James D. McKnight and Alfred W. Brown. 48 pages, 6½ x 10 inches. 17 plates. Published by the Technical Publishing Co., Ltd., 55 and 56 Chancery Lane, London, England.

There are many books on the design of steam boilers in general, but heretofore the field of the multitubular marine boiler has not been dealt with very fully by the various writers on the subject. As explained by the authors of the book, it is a treatise intended primarily for the use of such engineers and draftsmen who have had most of their experience in engine design and who are desirous of knowing more about the boiler side of their business. With this object in view the authors have attempted to lay down the principles of design in order that the customary long period of drafting-room training might be materially reduced. The reasons and laws governing the size of boilers, such as steam capacity and the merits of the different types, are not brought up, for as previously mentioned the book deals solely with the draftsmen's work, which consists of designing to the requirements of the various surveys. The seventeen plates are from actual working drawings and are illustrative of the practical nature of the work. Chapters are included on: Particulars of the Boiler, Position of Views, Furnace Centers, Tube Spacing, Detail of Furnace, Longitudinal Section of the Boilers, Firebox Side Stays and Bottom Joints, Detail of Firebox Top Staying, Staying in Steam Space, Staying of Firebox Backs, Details of Shell Riveting, Position of Breast and Bottom Water Space Stays, Detail of Portable Stay, Front and Back Tube Plate Staying, and other chapters of a minor nature. All the involved calculations are explained at some length, so as to be readily understood by anyone with a small mathematical foundation. Standard dimensions are tabulated in convenient forms for ready reference.

STANDARD PRACTICAL PLUMBING. By R. M. Starbuck. 406 pages, 6½ x 9½ inches. 347 illustrations. Published by Norman W. Henley & Son, 132 Nassau St., New York. Price, $3.

In this work Mr. Starbuck attempts to overcome what, to him, is the common failing of writers on such subjects; he means the over-technical manner in which the matter is usually broached. The mathematical treatment is very limited, it being the author's purpose to present the subject as simply as possible, and where any such calculations are involved, simple arithmetical methods are given. Minor details, too frequently omitted in such books from a failure on the part of the writer to grasp the reader's position, are gone into just fully enough to still remain interesting to all. The thirty chapters are on the following subjects: Plumbers' Tools, Wiping Solder, Joint Wiping, Bad Work, Traps, Syphonage of Traps, Venting, Continuous Venting, House Sewers and Connections, House Drains, Soil Piping, Main Trap and Fresh-air Inlet, Floor Drains, Yard Drains, Cellar Drains, Rain Leaders, Fixture Wastes, Water Closets, Local Ventilation, Modern Improved Plumbing Connections, Plumbing for Residences, Plumbing for Larger Buildings, Modern Methods and Devices in Country Plumbing, Filtration of Sewage and Water Supply, Hot- and Cold- Water Supply, Range Boilers and Theory of Circulation, Circulating Pipes, Problems on Range Boiler Work, Hot Water Supply for Office and Apartment Buildings, the Water Lift and its Applications, Multiple Connections for Hot Water Boilers and Radiators and Coils Heated by Range Boilers, Theory for the Plumber, and Drawing for the Plumber. The 347 illustrations tend to make the work very intelligible to all. One thing that strikes us in particular in the work is the large number of ways shown for connecting up hot water boilers, a subject that to the majority seems quite obscure, but which is here explained in an interesting manner, making that particular branch of plumbing very clear.

AMERICAN MACHINIST GEAR BOOK. By Charles H. Logue. 348 pages, 6¼ x 9¼ inches. 302 illustrations. Published by the *American Machinist*, New York. Price, $2.50.

The work is written essentially for the mechanic in the shop, to present to the latter practical data on cutting, molding, and designing of commercial types, and these subjects are presented in plain language by the use of simple rules, diagrams and tables, arranged for ready reference, in order that accurate information may be obtained quickly, when occasion arises, without a complete study of the subject having to be made to ascertain the desired information. Having this in view, we believe that Mr. Logue has carried out his object, and at the same time has presented deeper technical knowledge of the principles of gearing for those who desire to carry their studies further. In the introductory chapter the two principal types of gear teeth are explained, showing the development from the early days when they were first introduced. The underlying principles of gearing are shown and the manner of tooth generation illustrated. Proceeding, the interference of involute gears is discussed, and formulas and diagrams shown for the location of the point of interference. The advantages of a universal standard follows a brief outline of those at present existing, and succeeding this are buttressed teeth, stepped teeth, hunting teeth, and definition of pitches, the different ones being clearly differentiated. The second chapter deals with spur gear calculations, followed by a chapter on speeds and powers in which speed ratio, gear trains, power ratio, factor of safety and strength of teeth, as well as other similar matters, are discussed. Chapter four deals with gear proportions and details of design, where such matter as formulas, weight, key-seats, and other details of importance to the designing draftsman are discussed at some length. The theory, actual construction and manufacture of bevel and worm gears are investigated in the next two chapters, the subject being very fully dealt with. The chapter on worm gears contains a short dissertation on the Hindley worm. Following are chapters on the less important gearing subjects, such as helical and herringbone gears, spiral gears, skew bevel gears, intermittent gears, elliptical gears, epicyclic gear train, friction gears, odd gearing, pattern work and molding, with a final chapter on suggestions for ordering gears. The whole is treated in a comprehensive manner and is fully illustrated.

FACTORY ORGANIZATION AND ADMINISTRATION. By Hugo Diemer. 317 pages, 6½ x 9½ inches. Published by McGraw-Hill Book Co., New York. Price, $3.00, net.

In this intensely practical age, when everything that can be systematized is undergoing that process, there is plenty of room for another good book on the above subject. This book is as up-to-date as it is possible to be, and can be looked upon as an authority, for Prof. Diemer has had many years' experience, not only as professor of industrial engineering at the Pennsylvania State College, but also as a consulting industrial engineer. His name has always been linked with any improvement in industrial engineering education. In all, there are twenty-six chapters—devoted to the various branches of the subject. In the first chapter, entitled "Industrial Engineering," a brief review of the development of the last twenty years is given, emphasizing the hard road the mechanical engineer has trod in coming into his own, that is, in having industrial engineering recognized as a part of the work of the mechanical engineer. Chapters are included on the economic theory of factory location, the planning of factory buildings and the influence of design on their productive capacity, staff and departmental organization, executive control in the factory, departmental reports, the general office, the order department, bills of material, the drafting department, the pattern department, the purchasing department, stores and stock departments, the production department, foundry systems, the machine shop and tool department, shipping and receiving departments, time taking, cost department, aids in taking inventory, inspection methods in modern machine shops, employment of labor and labor problems, wage systems, fixing of piece-work rates, principles underlying good management, and a bibliography of works management. From a glance at the above list, it will be seen that the subject is treated in a comprehensive manner. In addition to the text matter, the book is made more intelligible and practical by the addition of 150 illustrations of card forms, etc., the majority of which are taken from actual practice. An interesting feature of the book is the last chapter, in which some twenty-seven books on the subject are briefly reviewed, the salient features of each being pointed out, so that the interested student of industrial engineering may continue his researches as deeply as desired.

CATALOGUES AND CIRCULARS

E. G. SMITH, Columbia, Pa. Catalogue of Columbia calipers and "Which Way" pocket levels.

AJAX MFG. Co., Cleveland, O. Reference book and catalogue of Ajax hot metal working machines.

NUTTER & BARNES Co., Boston, Mass. Circular illustrating and describing 8-inch, 1910 model metal saw cutting-off machine.

GENERAL ELECTRIC Co., Schenectady, N. Y. Bulletin No. 4777, an attractive and profusely illustrated booklet on building lighting.

HENRY I. LEA, consulting gas engineer, Peoples' Gas Building, Chicago, Ill. Illustrated blotter showing one of Mr. Lea's installations.

JOSEPH DIXON CRUCIBLE Co., Jersey City, N. J. Booklet on the protection of steel cars by the use of Dixon's silica graphite steel car paint.

WELLS BROTHERS Co., Greenfield, Mass. Catalogue No. 28 on bolt cutters, nut tappers, pipe threaders, and general information on threading.

GOLDSCHMIDT THERMIT Co., 90 West St., New York. Pamphlet descriptive of the thermit process of rail welding, the process being well illustrated.

GOLDEN-ANDERSON VALVE SPECIALTY Co., Pittsburg, Pa. Catalogue No. 14, on valves of all kinds for water and steam, and for steam and water specialties.

CRANE Co., Chicago, Ill. Special steel catalogue No. 70 on Crane cast-steel valves and fittings for high pressures, steam and water, and superheated steam.

QUEEN & Co., INC., 1211-1217 Arch St., Philadelphia, Pa. Circular listing Acme Helio blue process papers which are supplied in four grades and several weights.

BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa. Record No. 67, descriptive of locomotives recently built for passenger service, with illustrations and general dimensions.

BELLEVUE FURNACE Co., Detroit, Mich. Catalogue describing and listing Bellevue furnaces for heat treating, casehardening, tempering, brazing and forging by gas or oil.

JOSEPH TRACY, 116 West 39th St., New York. Circular illustrating and describing fan dynamometers adapted to testing the power of automobile and other gas engines.

ALLIS-CHALMERS Co., Milwaukee, Wis. Bulletin No. 4025, describing Allis-Chalmers motor-driven air compressors for industrial purposes, illustrating their varied uses.

INSTITUTE OF OPERATING ENGINEERS, Engineering Societies Bldg., 29 West 39th St., New York. Prospectus containing the proposed constitution, by-laws and plan of organization of the institute.

HENDEY MACHINE Co., Torrington, Conn. Catalogue on Hendey milling machines, plain and universal, column and knee pattern, constant-speed drive and belt cone types, and attachments for the same.

AUTOMATIC TRANSPORTATION Co., 2933 Main St., Buffalo, N. Y. Booklet describing the automatic system of transporting ore, mail, baggage, etc., on elevated tracks and also the underground, flexible, and independent systems.

WESTINGHOUSE, CHURCH, KERR & Co., engineers, 10 Bridge St., New York. Booklet relating to the work performed by this company on the New York passenger terminal and improvements of the Pennsylvania and Long Island Railroads.

CROCKER-WHEELER Co., Ampere, N. J., has issued a bulletin, No. 120, on Form I. motors, which contains a large amount of useful information on direct current motor design, with illustrations showing various examples of motor-driven machinery.

C. U. SCOTT, Davenport, Ia. Illustrated catalogue on heat treating and hardening of steel, gas blast furnaces, tempering furnaces, high-speed steel furnaces, fuel gas plants, pressure blowers, cooling tanks, pyrometers, calorimeters, brazing furnaces and bench torches.

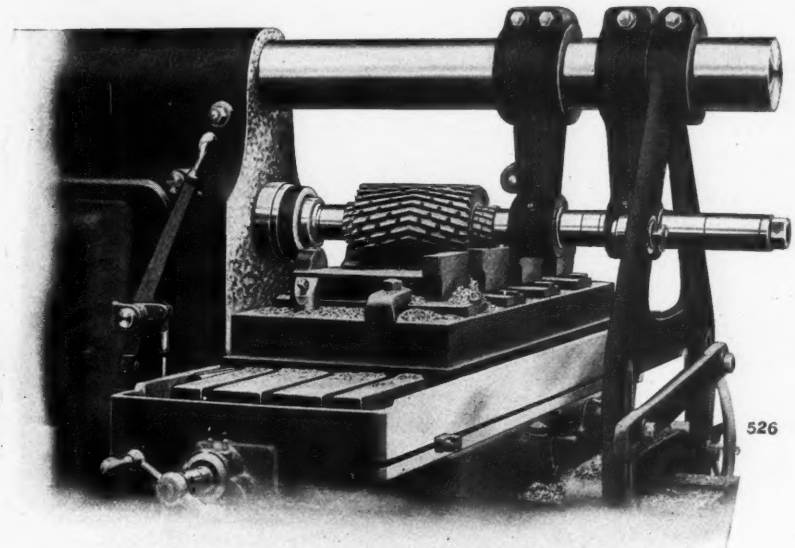
C. J. ROOT Co., Bristol, Conn. Catalogue of the "Bristol," "Elm City," and "Ro-co" counters. These counters are made to register revolutions or strokes, to count by the pair, dozen or gross, and in capacities ranging from one hundred to ten millions. Applications to printing press, measuring machine and loom are illustrated.

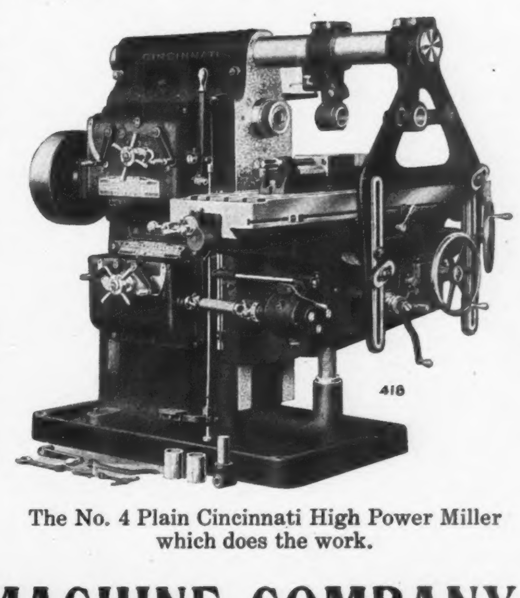
JOSEPH DIXON CRUCIBLE Co., Jersey City, N. J. Booklet entitled: "Graphite Products for the Railroad," 40 pages, illustrated. The object of the publication was to bring together in one pamphlet all the products in the Dixon line of interest to the mechanical departments of railroads. These include various graphite lubricants, protective paint, crucibles, etc.

AMERICAN SWISS FILE & TOOL Co., Elizabethport, N. J. E. P. Reichhelm & Co., distributors, 24 John St., New York. Price list of American Swiss files. It is a complete catalogue, illustrating and listing the line made by this firm. Files for all classes of work, from the heavy rasp down to the die-sinker's and silversmith's riffler, are illustrated in their varied forms.

NATIONAL-ACME MFG. Co., Cleveland, Ohio. Loose-leaf wall calendar, November, 1910, to October, 1911. The loose leaves are held in a suitable pocket or receiver and may be transposed from month to month, to display the current month. The upper part of the pages illustrates the Acme multiple-spindle screw machine and its tools and products. The calendar is an artistic creation that must be seen to be appreciated.

L. S. STARRETT Co., Athol, Mass. Catalogue No. 19 of fine mechanical tools. This well-known catalogue of machinists' tools continues to grow; No. 19 contains 274 pages, 42 more than in the last issue, No. 18, and over 350 illustrations. Among the new tools listed are shrink rules, metric keyseat rules, builders' combination tool, double square,





CONTENTS FOR DECEMBER

The first column of page numbers applies to the Engineering and Railway Editions; the Second to the Shop Edition.

vernier calipers, micrometers, protractors, metric micrometer depth gage, hack saws, frame tension pliers, ratchet wrench, etc.

Bristol Co., Waterbury, Conn. Bulletins No. 128 on Bristol's round form, Class II recording thermometers; No. 129 on Bristol's thermometer—thermostats; No. 135 on the Wm. H. Bristol recording shunt ammeters; No. 141 on Bristol's round form recording pressure gages; No. 145 on Bristol's class II indicating thermometer; No. 146 on Bristol's long-distance recording tachometer, and No. 147 on the Bristol-Durand radii averaging instruments.

Crocker-Wheeler Co., Ampere, N. J., has recently placed a line of lighting transformers before the public under the trade name of "Remek." (In the Hungarian language "remek" means masterpiece.) These transformers are different in design from any other on the market. The core loss is low and average efficiency high, both advantages having been combined with other valuable features. The descriptive bulletin, No. 125, contains much valuable information to users of lighting transformers.

Dodge Mfg. Co., Mishawaka, Ind. Pamphlet describing severe test of a wood-rim pulley made by the company. The test was made on a Dodge iron-spider, wood-rim pulley, 46½ inches in diameter, 16-inch face, 4-inch bore, which was to run at the high speed of 9000 feet per minute, to meet the customer's requirements. The company decided to make a conclusive test, and rigged up for the purpose in a vacant room. The pulley was run up to 2400 revolutions per minute without perceptibly weakening it at any point. The result of the test was over three times that required by the customer, being 29,200 feet or a little over 5½ miles rim travel per minute.

Westinghouse Machine Co., East Pittsburg, Pa. Reprint from the New York *Tribune* of October 23, 1910, entitled: "George Westinghouse and His New Inventions," describing the pneumatic spring for automobiles which Mr. Westinghouse believes will supersede the pneumatic tire. The pneumatic spring is shockless and is expected to be more economical in use than the pneumatic tire. It automatically pumps up the required pressure for carrying the load. The reprint also describes the Melville-Macalpine gear for reducing the speed of marine turbines to the economical speed for screw propulsion, thus making the use of direct-connected steam turbines for marine propulsion practicable and economical for all conditions of service.

R. K. Le Blond Machine Tool Co., 4609 Eastern Ave., Cincinnati, Ohio. Catalogue of the Le Blond cutter and tool grinder, illustrating its construction and application to grinding many classes of work, comprising spiral milling cutter, double angle cutter, cut-off saw, hand reamer, taper roughing reamer, circular form tool, universal grinding attachment, inserted tooth milling cutter, side teeth of a side milling cutter, four-lipped drill, double taper stem reamer, angular cutter, etc. The list of illustrations mentioned is only a part of the views contained in this interesting and attractive catalogue, which should be in the hands of every tool-room foreman and machine shop employe responsible for the maintenance of tool-room equipment.

Crocker-Wheeler Co., Ampere, N. J., points out in its recently issued bulletin that large direct current machines hold an important place in our modern industrial development. They are applied as motors on nearly all large machinery for every class of work from the making of paper to the manufacture of steel. As generators they have often demonstrated their usefulness where more power has been needed in a hurry and also when cost has been an important consideration. In such cases spare engine capacity makes the belt type generator the cheapest and quickest method of supplying the need. The pamphlet illustrates the construction of the magnet frame, armature and commutator, the design and method of application of the field coils, the arrangement of the brush rigging, etc.

TRADE NOTES

Toledo-Massillon Bridge Co., Toledo, Ohio, has changed its name to Toledo Bridge & Crane Co.

Jones & Lamson Machine Co., Springfield, Vt., has not begun the construction of a new shop. The statement published in the November number was erroneous.

W. F. & John Barnes Co., 231 Ruby St., Rockford, Ill., manufacturer of drilling machinery, was awarded a gold medal for its display at the Brussels Exhibition.

Davis Expansion Boring Tool Co., formerly of 237 North 2nd St., St. Louis, Mo., has changed its name to Matthews-Davis Tool Co., and is now located at 219 North 2nd St., St. Louis.

United Engineering Co., Bridgeport, Conn., is a newly formed corporation. The company is prepared to design special machinery, press tools, jigs, fixtures, etc., and to develop inventions and modernize manufacturing methods.

E. Horton & Son Co., Windsor Locks, Conn., was awarded a medaille d'or (gold medal) for its exhibit at the Brussels Universal and International Exposition, 1910. This is the highest award ever given for chucks and is next to the "grand prix," the highest award possible for anything.

Foote-Burt Co., Cleveland, Ohio, manufacturer of multiple-spindle drilling machines, "Reliance" bolt cutters and nut tappers, has opened a sales office in Detroit to take care of the territory adjacent. The office will be located at 827 Ford Bldg., and will be in charge of Mr. H. C. Rose, manager.

Landau & Howe have succeeded to the engineering business of Landau & Golden. They will retain the offices at 1779 Broadway, New York, and will carry on a consulting and designing business with special attention to the automobile and kindred power applications and tests of materials and mechanisms.

Davis Expansion Boring Tool Co., St. Louis, Mo., was reorganized in September and the name changed to Matthews-Davis Tool Co.; address, 219 North 2nd St., St. Louis, Mo. The officers are W. N. Matthews, president and treasurer; Emery E. Davis, vice-president and general manager; and Claude L. Matthews, secretary.

Pawling & Harnischfeger Co., Milwaukee, Wis., manufacturer of traveling electric cranes, horizontal drills, boring machines, etc., has opened a branch office in the Washington Building, Portland, Oreg., in charge of Mr. R. K. Morse, who, for some years past has been a member of the company's engineering staff at the home office.

According to the *Business Monthly*, plans have been completed and contracts are soon to be awarded for new foundries and shops for the Westinghouse Electric & Mfg. Co. The plant, which will be located on 70 acres of ground recently purchased at Trafford City, near Pittsburg, Pa., will represent an investment of approximately $3,000,000, and will employ at least 3000 men when completed.

Republic Iron & Steel Co., Pittsburg, Pa., has just made a contract with the Westinghouse Electric & Mfg. Co. for seventy-nine crane and mill motors aggregating about 5000 H. P. to be used in the steel company's mill at Youngstown, Ohio. The contract also includes magnetic controllers for the larger motors and manually operated controllers for the smaller motors.

Bickford Machine Co., Greenfield, Mass., is the successor of Bickford & Washburn, Inc. At a meeting of the stockholders, November 5, Mr. H. L. Washburn, who recently disposed of his interest in the firm, resigned his position as secretary and director. The personnel of the officers is as follows: O. S. Bickford, president and treasurer; L. B. Weissbrod, secretary; O. S. Bickford, L. B. Weissbrod and A. L. Smith, directors.